Design Engineering

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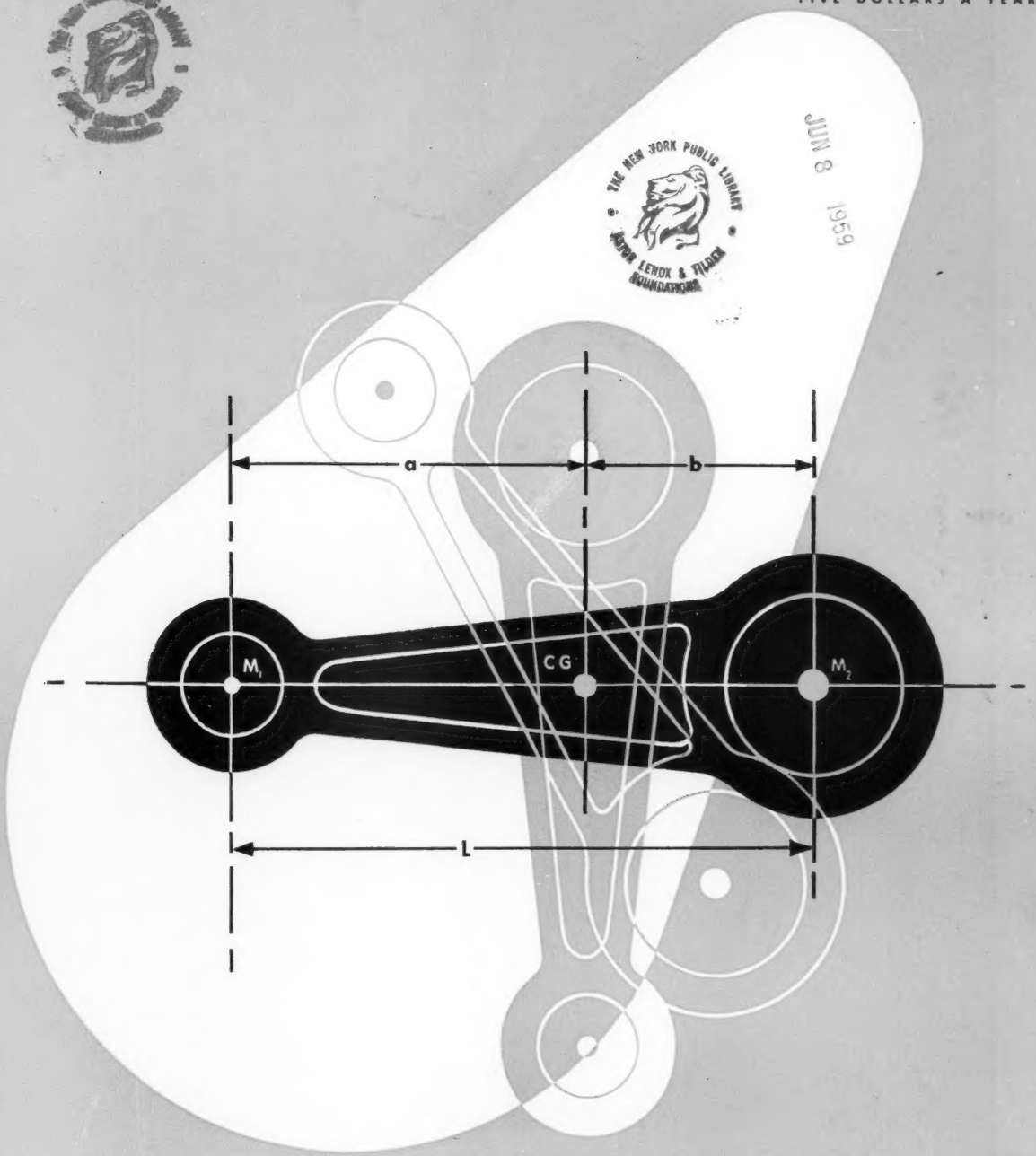

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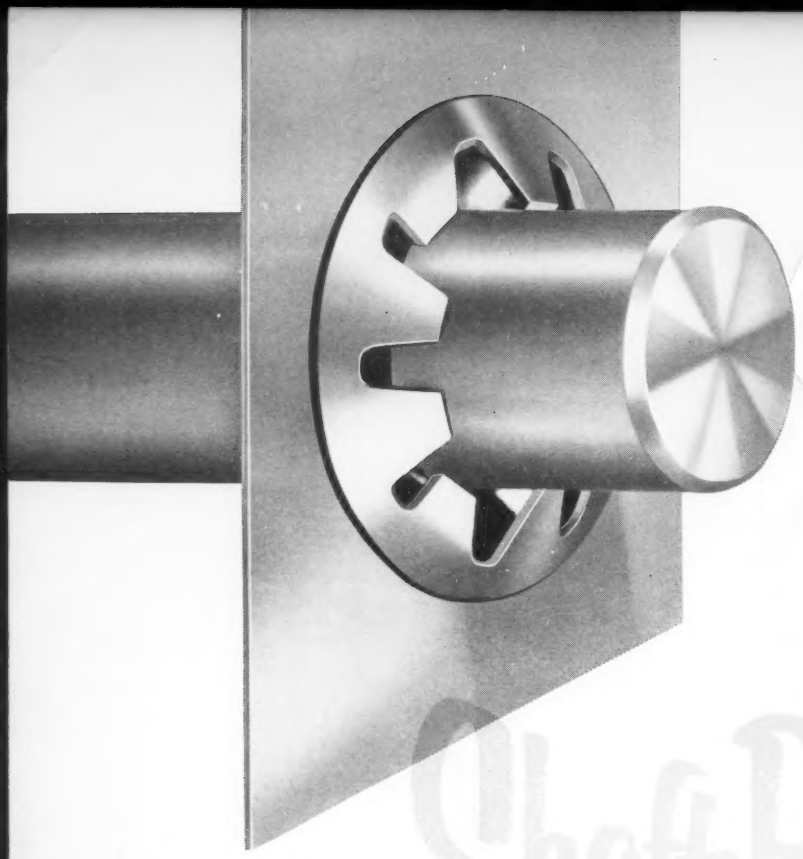
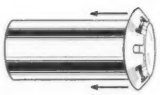
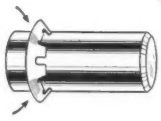




Pilot teeth guide fastener on for easy hand starting.



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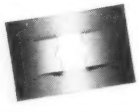

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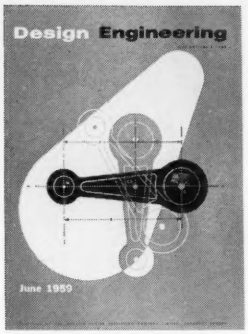

Design Engineering

Vol. 5 JUNE 1959 No. 6

This month's cover

The article on consolidation of masses set the theme—and part of the work pattern of a connecting rod is depicted. As you will observe, M1, CG and M2 are the vital points of this cover story, and govern movement of the component. Gerald Bern looked after the artwork.

Design Engineering

MEMBER

CCAB

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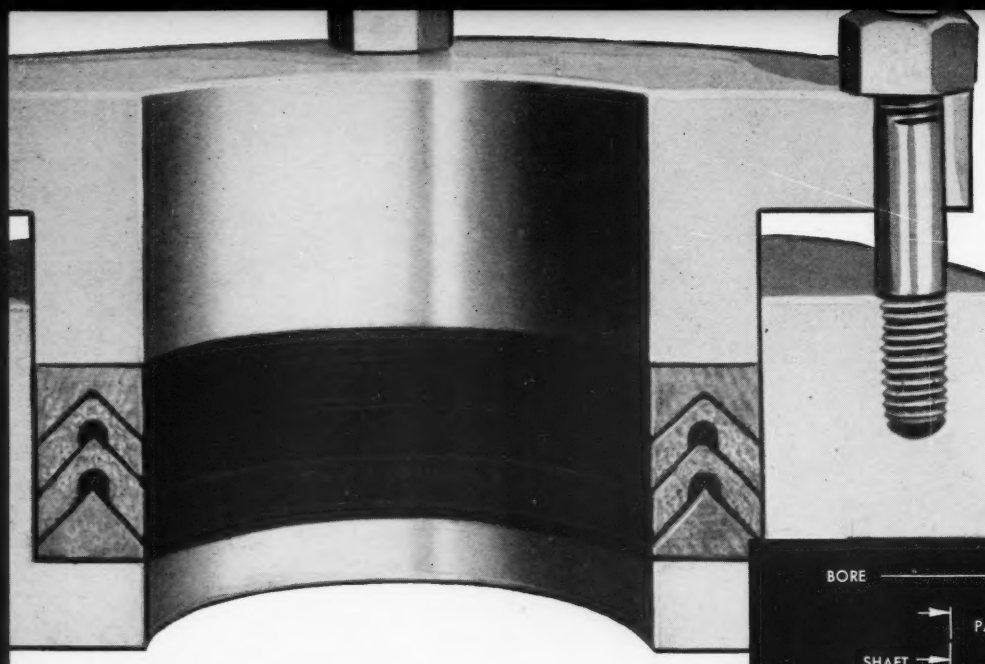
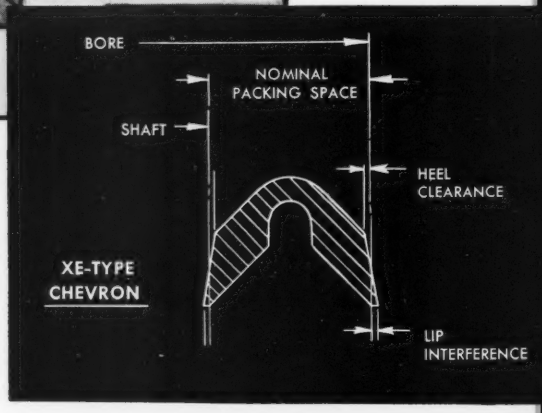
VDA DESIGN



MORE ABOUT THE GARLOCK **2,000**



HOW LIP INTERFERENCE AND HEEL CLEARANCE IMPROVE CHEVRON* PACKING DESIGN

There are many reasons why users prefer famous Garlock CHEVRON Packings for sealing rams or rods on hydraulic systems. Design refinements indicated in the drawing above are just two examples:

Heel clearance for easy installation. Experience has shown that unless adequate clearance is provided at the heel of a V-type packing ring it can be very difficult to insert in the stuffing box. The heel clearance on Garlock CHEVRON Rings has proved to be the ideal for easy installation without disturbing the unique advantages of the CHEVRON design.

Lip interference for sealing at low pressures. If the lip of a V-type packing is made exactly to nominal size, and all the clearance taken at the heel, leakage past the lip often occurs at low or zero pressures. On the other hand, too much interference at the lip generates excessive friction resulting in scoring and wear. The lip interference on Garlock CHEVRON Packing is your assurance of minimum friction and positive sealing at all pressures.

There are many other design advantages of Garlock CHEVRON including its hinge-like construction which automatically compensates for pressure changes. If you have a sealing problem involving lubricants, liquids, or solvents at temperatures ranging from −320°F to +600°F, why not find out more about the many forms of Garlock CHEVRON Packings available.

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KAILL

New hand at the helm

The new editor of **DE** is **A. Douglas Kaill.** Born in Halifax, N.S., in 1915, he came to Toronto in 1934. He worked in the advertising and sales promotion field and was first editor of Philatopic Monthly, a publication devoted to stamp collecting. During five years' war service with the Royal Canadian Signals Corps, he was an instructor and supervisor of the drafting office. After discharge he entered Queen's University, and in 1950 graduated with a B.Sc. in Engineering. He has worked in industry with major companies like C.I.L., Dupont of Canada and Canadian Westinghouse. With the latter, he was engineering standards supervisor. In December, 1958, he was appointed assistant editor of Modern Power and Engineering, another Maclean-Hunter publication. Kaill is a member of the Association of Professional Engineers of Ontario, and is a charter member of the Toronto-Hamilton section of the Standards Engineers Society. Married, with two daughters and a son, his hobbies are widely dispersed. Oil painting, growing African violets, sports — and playing brass instruments keep him busy at home as he will be in his new appointment.

* * *

Morse to Blighty

His many friends in engineering and publishing circles will wish "bon voyage" to **W. L. (Bill) Morse** who returned to England during the last week of May. Bill was editor of **DE** from its inception, and was responsible for the high standards of technical reporting this magazine follows. He has been appointed design editor of a leading British engineering publication.

* * *

Co-operative writing team

Both staff engineers with Servo Corporation of America, **Sabert Howell** and **Joseph Jerger Jr.** have broad experience in the infrared field. This ranges from military systems to commercial optical components. Howell is an Ohio State U man and holds patents for pyrometers and servo control devices. Partner Jerger has developed new infrared glasses and also holds patents on several related items. He is a graduate of Georgia Institute of Technology with degrees in chemical and ceramic engineering. No off-duty information to hand.

* * *

Family comes first

John Dennis was born in Malta, raised in India and England and has been enjoying life in Canada for the last six years. He has spent most of his working life in journalism. For added interest, he clicks a no mean shutter and is strong-willed enough to suppress a wild urge for sports cars. Two young sons claim priority — so he has to settle for mundane transportation — a miniature bus. ★

NEW SOLENOID VALVES *by* Airmatic

These corrosion-proof valves have only one internal moving part and a completely protected solenoid coil. The coil is fully sealed from air, oil, gas and water . . . and will not overheat on continuous duty. Coils for continuous or intermittent duty, a-c or d-c, are interchangeable.

Life expectancy is many millions of cycles and by renewing the one-piece valve plunger, many millions more can be expected. The plunger can be replaced without disturbing rigid piping.

DISTRIBUTORSHIPS FOR THESE NEW VALVES ARE AVAILABLE

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ORIFICES	1/16" THROUGH 3/16"	1/8" AND 3/16"
VOLTAGE	MOST A-C AND D-C	MOST A-C AND D-C
DUTY	CONTINUOUS	CONTINUOUS
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HEAT RISE	WITHIN UL LIMITS	WITHIN UL LIMITS

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Everything Under Control

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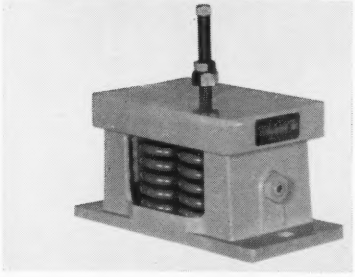
Reports

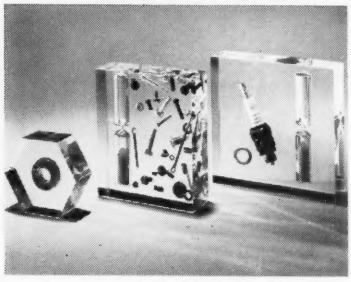
A news roundup of items of engineering and design interest from the world over

Soaks up shocks, isolator is preloaded



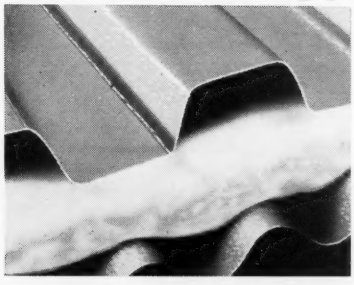
We are glad to report on another Canadian designed and manufactured product. It's a new vibration isolator, that looks as efficient in the steel as its performance does in print. We are told that standard steel isolators have static deflections as high as 10 in., permitting the efficient control of disturbing frequencies as low as 125 cpm. This one is said to permit even higher deflections. By using an internal pre-loading device which draws the springs down to within an inch or so of their final loaded height, the isolators with large static deflections are factory preassembled. This obviates field set-up and installation delays. Vibron Ltd. say that vibrators often eliminate need for heavy footings, allow use of semi-portable installations and of course, reduce transmitted shock. We could have used half a dozen of these on a car we once had.

Promoting the sparkle in your product



Getting an idea across is vital with any product — because good design doesn't necessarily ensure zooming sales. We were interested then to hear that a Canadian company is pushing a novel (though not new) promotional aid to give sparkle to sales. Embed the product in Lucite (an acrylic resin), and make the mold up as bookends, cuff-links, lighters, paper-weights and medallions. This technique permits electrical parts, nuts and bolts, spark plugs and what have you, to be transformed into powerful, constant selling aids. To do it, the plastics molder polymerizes to a high transparency a liquid monomer and powdered Lucite 41. Upon mixture, they dissolve and can be poured into the mold. Casting is then gradually built up with a pour and cure process. A hearty buffing and polishing imparts the zing, says Unique Novelties.

Quick way of building pilot plants

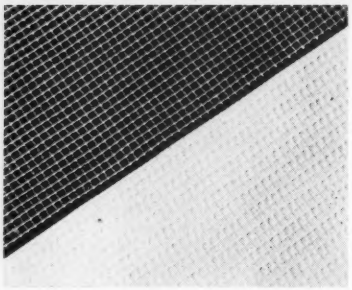


The horizon for stainless steel continues to widen. Illustration shows a mechanically assembled panel sandwich. On one side is corrugated stainless steel, on the other a fluted metal panel with a core of glass fibre insulation in the middle. The idea is being used extensively for factories, pilot plants and office buildings. Exterior walls can be assembled on the site and windows, sills, doors and trim made up to match. Apart from the accepted advantages of the material, it gets top marks for service life and maintenance and its resistance to industrial atmospheres. If you look around your community you'll probably find it in use.

Hollow core tv antenna has built-in ladder

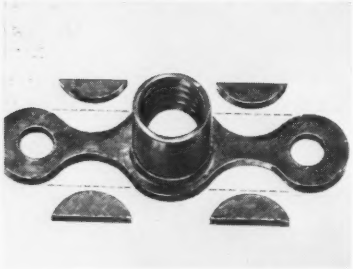
We hope the sight of these parka-covered engineers will cool you down in the sweltering June heat. They are fastening sleet-melting units to the slot-lip of a 700-ft. tall tv antenna in Rexdale, Ont. According to Edgar J. Gareau, broadcast specialist for the electronic and tube department of CGE, the antenna is designed for use on low channels four to six. He said it is now practical to build high gain antennas which allow the maximum permitted effected radiated power with medium power transmitters. Antenna consists of a hollow, constant diameter mast, an RF power feed system and sleet melting equipment. It is made of structural steel galvanized inside and out, and has a rung ladder on the inside to allow inspection.

Paper and scrim unite for more tensile strength



We understand that most papers incorporating glass are made up as separate sheets and the glass laminated between them. A company in upstate New York has come up with an idea for producing a saturating base paper with an integral glass scrim or screen built-in at time of manufacture. Process eliminates the possibility of changes in the paper's characteristics that occur when the glass is laminated between two sheets. Without the scrim, paper has a lengthwise tensile for a one-inch strip of 20 lbs. Same amount with scrim—60 lbs. Upper diagonal of photo shows glass scrim and below, paper and scrim united. Sounds also like a case of hefty production savings.

Weekending on Mars looms nearer

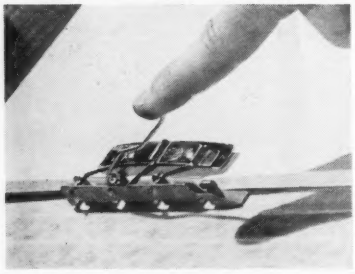


As we have said in these columns before, there is a current healthy trend afoot towards miniaturization, weight-saving and a general tightening-up in design work. Recognizing the need for reduced weight in modern aircraft and space vehicles, a company went to work on one of the least glamorous components — the anchor nuts. They removed excess metal without any sacrifice in full performance — came up with a 23% saving in weight. Then this done, they pared away at single lug, two lug and corner type anchors till they had a collection to suit the market. With all this saving, we expect to be weekending on Mars well ahead of our last prediction.

Dredge carries battery of hydraulic equipment

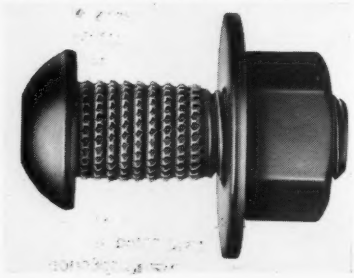
Not a pirate shrimp boat in the St. Lawrence Seaway, but a dredge of tomorrow. The "Andrew B" operates in the Welland Canal and is frankly a breeding ground for hydraulic equipment. This includes two piston-type pumps, four piston-type motors, three vane-type motors, two cylinders and necessary valving filters and accessories. Two warping winches of a three drum design, also have hydraulic power independently controlled at each winch. The dredge also features push-button control of spuds used to secure its position. Notice how the shovel (it has a 5½ cubic yard bite), is mounted on a turret built into the hull. Russell Construction Co. own the craft and Vickers Inc., looked after hydraulics.

Finger on the spring keeps papers under control



Superlatives fly thick and fast when many new products make their debut — and we resist them because of their commonplace nature. But the punchless binder clamp at left is said to be the latest aid in keeping papers under control. A finger on the spring is sufficient to open or close the clamp. The spring itself has a one half inch capacity — but is said to hold even one sheet of paper with a bulldog grip. Clamp comes mounted in binders of different sizes and handles blueprints, catalogues, charts, cheques, and personal papers. And it has a punchless action. For people who seem to have a penchant for cluttered desks we can tell you that the file is called "Accogrip."

No head washer needed with the knurled shank



This is one of the handsomest bolts we've seen in a long time. The shank is made with a specially formed knurl set in a spiral. This is to reduce the driving load. The thickness of the members to be joined determines the length of knurled body. With this bolt incidentally, no head washer is needed. The button head provides a bearing area comparable with a hex head high strength bolt and washer. Heat-treated of carbon steel, the knurly bolt meets ASTM A 325 specifications. If you examine the bolt closely, you'll see that the frontal shape of each knurl is a section of a small ball. The back face is relieved somewhat like a drill or tap to prevent packing of displaced material. Lamson and Sessions Co. are the designers and manufacturers.

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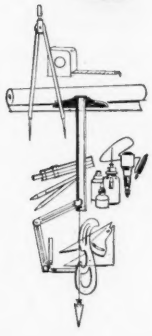

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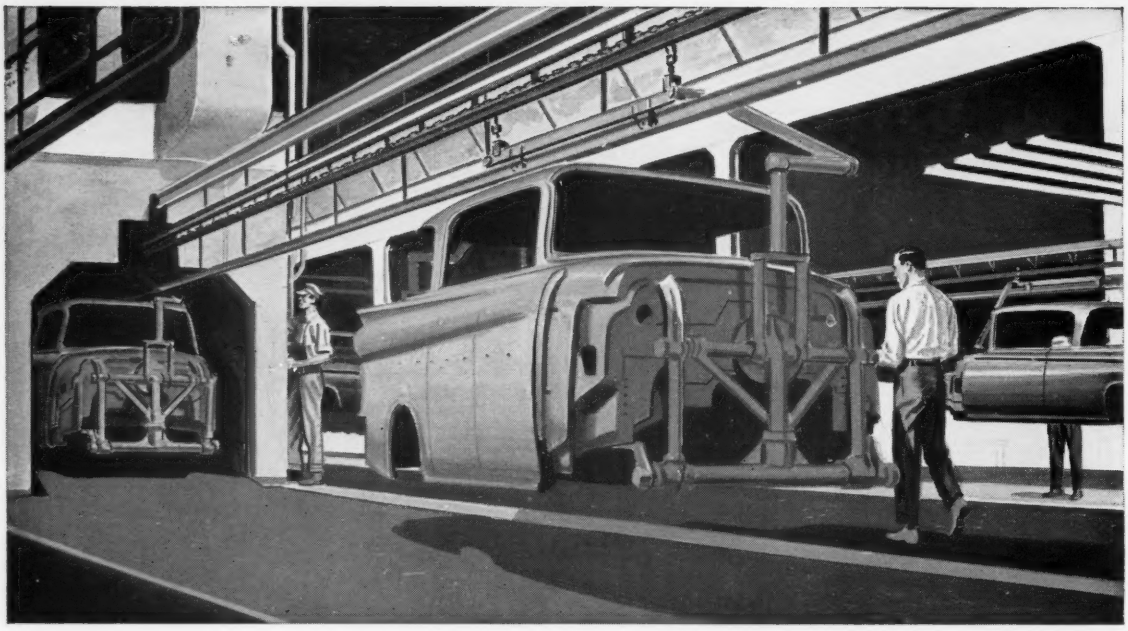


In the automotive industry alone, there are 30 Cold Bonderite installations.

How Cold Bonderite System cuts costs

Some actual user-experiences of savings in heat requirements, maintenance, water and electricity, and equipment after installing Cold Bonderite System.

Less than two years ago, the first public announcement of Parker's Cold Bonderite System was made.

Now, well over a hundred plants are using this revolutionary, money-saving system of phosphate-treating at low temperatures.

Some are among the country's largest plants, others are quite modest in size and production. Products treated range the list from automobile bodies to small appliance components.

From these users we have compiled a long list of documented savings records. In many cases, cost reductions have been greater than we had hoped to achieve.

The temperature tells the story! Cold Bonderite System solutions operate 60° to 75° cooler.

Heat Saved

The greatest percentage savings in heat requirements (90%) has been reported by an automotive plant. Before installing Cold Bonderite System, the finishing line used 50,000 pounds of steam an hour. Cold Bonderite in the line uses only 5,000 pounds per hour.

In another auto plant, heat savings are figured at 74% on a body line. A small parts finishing line in the same plant shows the same percentage reduction in heat requirements.

A manufacturer of metal cabinets reduced gas consumption for heating his phosphating line from 33,000 to 14,000 cu. ft. per day—a 56% reduction—by installing the Cold Bonderite System.

A famous maker of household equipment changed from conventional phos-

Circle number 140 on time saver card

phating to Cold Bonderite System and saw his steam use plummet 66%.

Another manufacturer, an Eastern small appliance maker, reports that on gas expense alone he has cut his phosphating costs 45%.

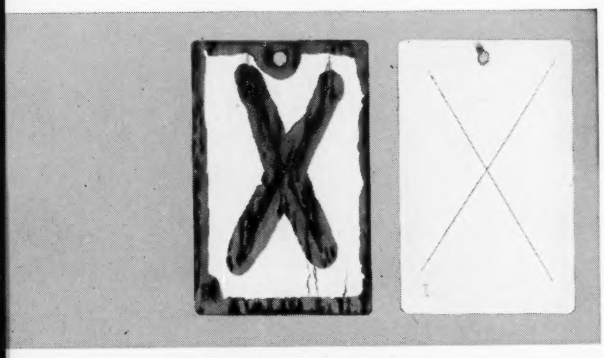
Other Savings Pile Up

The magnitude of other savings, beyond heat consumption, has been surprising to users and very good news to their cost accounting departments.

Electricity, for instance. At the greatly reduced temperatures of the solutions, there is no need to operate exhaust fans. In one installation, the change to Cold Bonderite eliminated the need for replacing a $15,000 exhaust system.

Water use is reduced about 25% because there is less evaporation.

Maintenance costs nosedive with Cold Bonderite System in the finishing line. Lower temperatures in the heating coils mean less frequent—or no necessity for—cleaning the coils. When there is service to be performed, the maintenance crew can move right in without waiting for the installation to cool off.



Comparative 48-hour salt spray test proves performance. Left, untreated panel; right, panel Cold Bonderite-treated before painting.

One user figures that he has eliminated 364 manhours of maintenance time yearly with his Cold Bonderite System.

The same manufacturer has discovered, too, that the reduced temperatures have allowed him to eliminate a number of steam traps and steam coils costing over $8,000.

Coating Quality Is High

While Cold Bonderite System is saving money on the phosphating line in these many ways, there has been absolutely no diminution of quality in the coatings or their performance.

The Bonderite coating produced by low-temperature Cold Bonderite System matches the high standards set by Bonderite for thirty years. In salt spray, humidity and outdoor exposure tests, as well as in actual service on automobiles, appliances, furniture and many other products, performance has been proven.

Results are uniform hour after hour and day after day. Control and operation of the system is simple and practically foolproof.

Chemical Costs Held Low

All the savings attained by the use of Cold Bonderite System are *real* savings. They show up on the P & L statement because *chemical costs for this revolutionary development are not increased.* The special Bonderites and Parco Cleaners are strictly comparable to conventional hot treatments in the cost of treatment per square foot.

Only Parker Has Cold System

There is, actually, no other system like it. Cold Bonderite System was developed by Parker research, tested and perfected by Parker chemists. It has been proven over and over again as the way to get superior phosphate coatings on steel with spectacular savings.

The Parker representative in your territory is ready to advise and work with you to change your phosphating installation over to Cold Bonderite System. Call him in or write direct to Parker, Detroit.

**Bonderite, Bonderlube, Parco, Parco Lubrite – Reg. U.S. Pat. Off.*

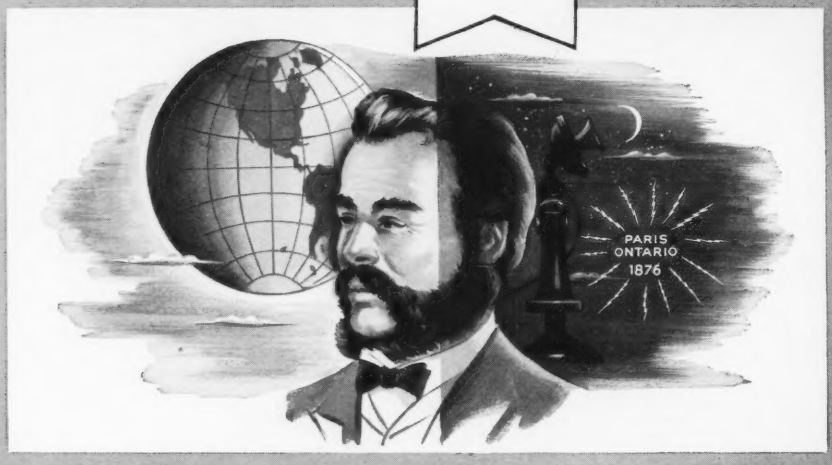
PARKER RUST PROOF COMPANY

OF CANADA LTD., REXDALE BLVD., REXDALE (TORONTO), ONTARIO

BONDERITE corrosion resistant paint base | BONDERITE and BONDERLUBE aids in cold forming of metals | PARCO COMPOUND rust resistant | PARCO LUBRITE—wear resistant for friction surfaces | TROPICAL—heavy duty maintenance paints since 1883

Circle number 140 on time saver card

A CANADIAN FIRST



THE FIRST LONG DISTANCE TELEPHONE CALL IN THE WORLD

AFTER EXTENSIVE *experimental work in Brantford and Boston, which resulted in the invention of the telephone, Alexander Graham Bell successfully carried out the first long-distance telephone call on August 10th, 1876 from Brantford to Paris, Ontario. It was the beginning of "long distance" which now links all parts of the world.*

In telephone communications and in the fields of electronics and electricity, Modern Metals find countless applications in the development of dependable equipment for generation, transmission and distribution. In your own business you, too, will find these Modern Metals equally important and their properties of corrosion, heat and stress resistance of vital interest.

As specialists in the field of Modern Metals and with the cooperation of major sources of supply, "ALLOY" bring you all the knowledge, information and technical assistance you wish to make sure you are using these Modern Metals to full advantage in improving product or process, and in developing new products to meet today's changing markets.

This service is backed up with supplies of Modern Metals, in all forms, available from our warehouses located conveniently to serve you.

For Assistance . . . For Service — "CALL ALLOY"

ALLOY METAL SALES LIMITED

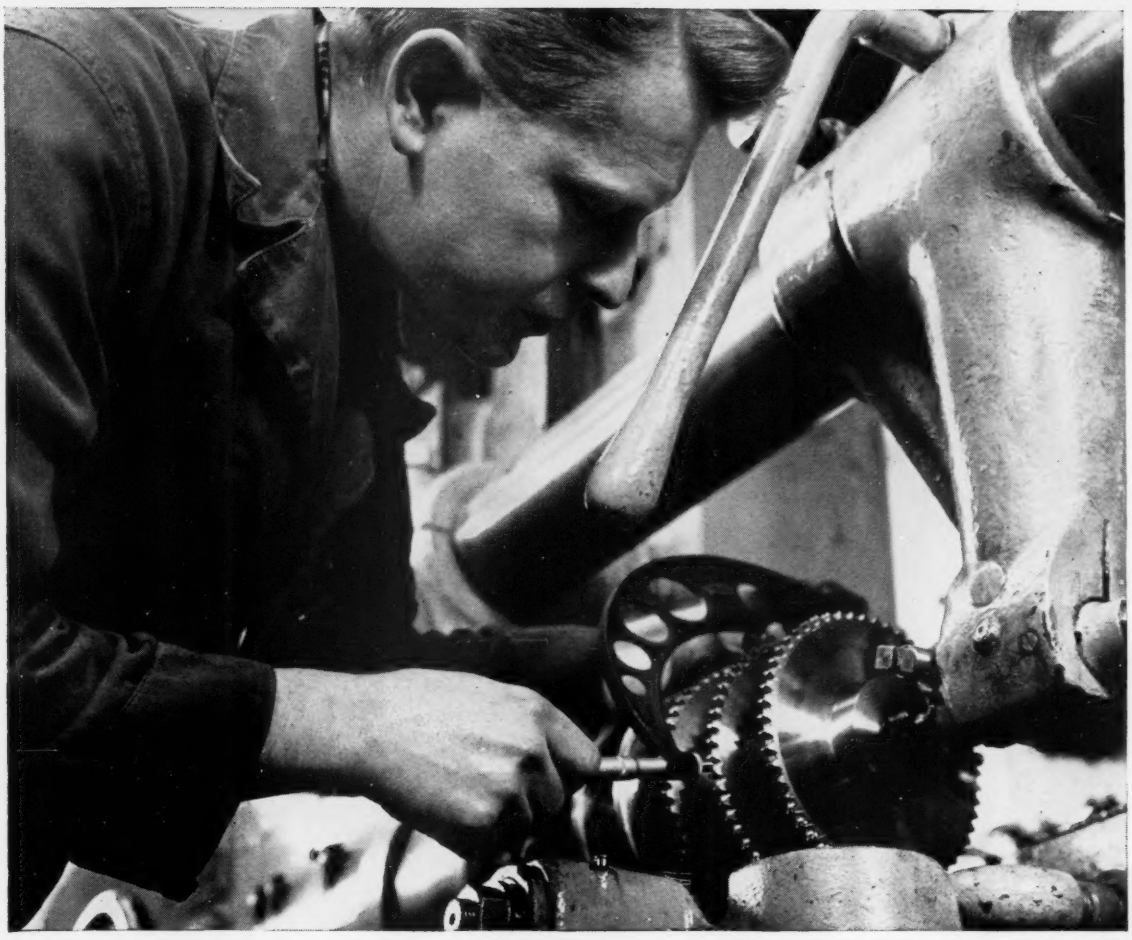
TORONTO • ONTARIO

One Source . . . Complete Responsibility . . . for all the Modern Metals

NICKEL • NICKEL ALLOYS • STAINLESS STEEL • ALUMINUM • ACCESSORY PRODUCTS

Circle number 103 on time saver card

Meet Cliff Landers of Simcoe, Ontario



THE MAN FROM MORSE

WHO MACHINES THE SPROCKETS

THAT DRIVE THE CHAINS

THAT ALL OF CANADA USES

Cliff Landers works at Morse Chain of Canada. He feels a certain pride in the knowledge that he is producing the finest sprockets—for the finest chains—for use throughout Canada. And rightfully so!

Precision engineering and uniform high quality are important in sprockets—and in timing chain, too. Morse Automotive Timing Chain sets the quality standard for the automotive industry . . . and is specified as original equipment on every Canadian-built automobile.

So whenever your needs call for chain, sprockets, speed reducers, couplings or clutches, your Morse Distributor is the man to see. You'll find him listed in the Classified Directory under "Power Transmission". Or, for further information, call or write: Morse Chain Of Canada, Ltd.—A Borg-Warner Industry—Simcoe, Ontario. Phone Garfield 6-4960.

BUY CANADIAN

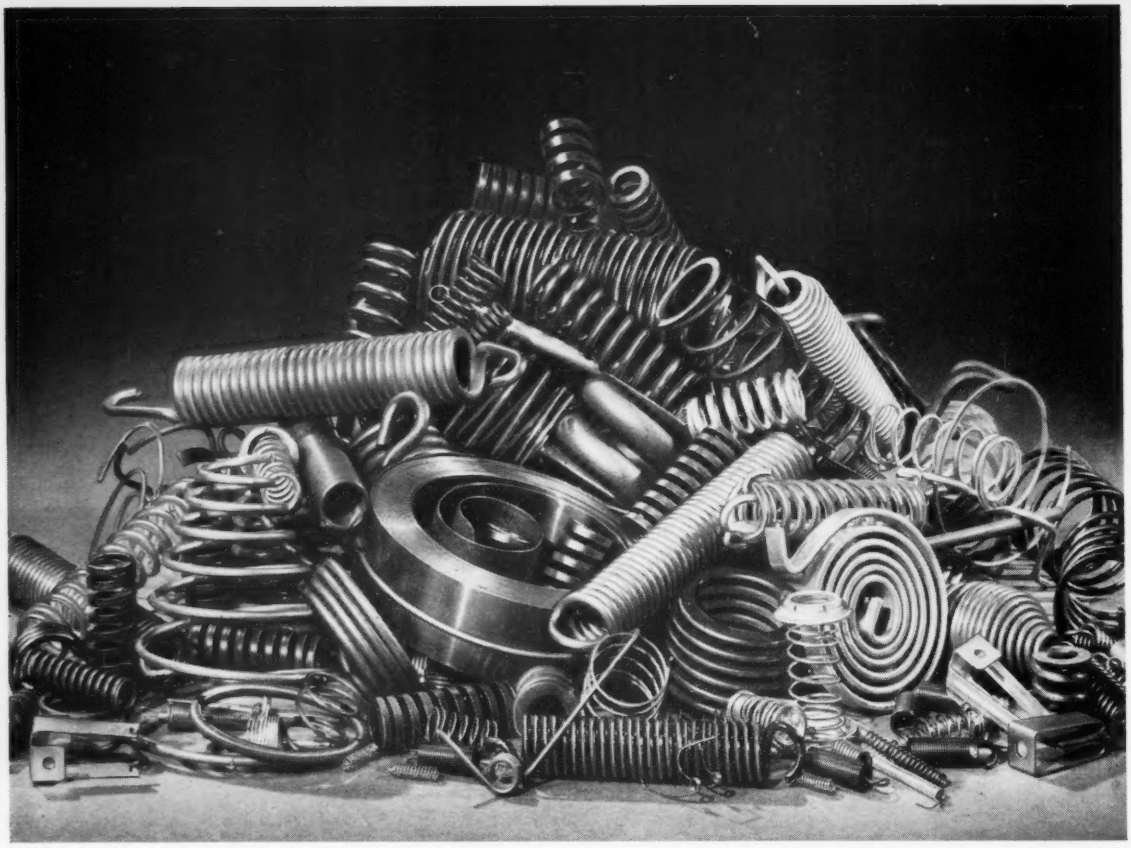
MORSE

MORSE BW BORG-WARNER

*Trademark

A BORG-WARNER INDUSTRY

Circle number 137 on time saver card



needle in a haystack?

Finding just the right spring can be costly and time-consuming. Even though springs look alike, each is different—depending on the job it has to do. Type, size, tension, temper, stress, and other complicating factors must be considered in their design and manufacture.

If finding the right spring for *your* problem seems like "looking for a needle in a haystack," let the man from Wallace Barnes help you. Our spring engineers are ready to accept your precision mechanical spring problem and help design the *right* spring to do your job *precisely* right.

Send for your free copy of
Spring Design and Selection—in Brief
our authoritative digest on spring engineering

Selecting the right spring is simple . . .

Just call the man from

The Wallace Barnes Company Ltd.

Hamilton, Ontario—Montreal (Pointe Claire) Quebec

Sales Agent: E. A. Tipping Sales Ltd., Winnipeg—Vancouver (Richmond)

Subsidiary of Associated Spring Corporation

64-205R

Circle number 155 on time saver card

GeMex plastics mean *Savings* for Appliance Manufacturers

Illustrated above:
"Coldspot" Refrigerator
Plastics by: GeMex.

plastics experts for 50 years

The modern refrigerator is only one of many appliances which benefit from use of highest quality GeMex plastic components by G.M. PLASTIC.

GeMex freezer doors, chiller trays, crispers, pans, lid panels . . . all these and many more units are completely fabricated, assembled and finished by G.M. Plastic Corporation, a company with 50 years of experience in plastics production.

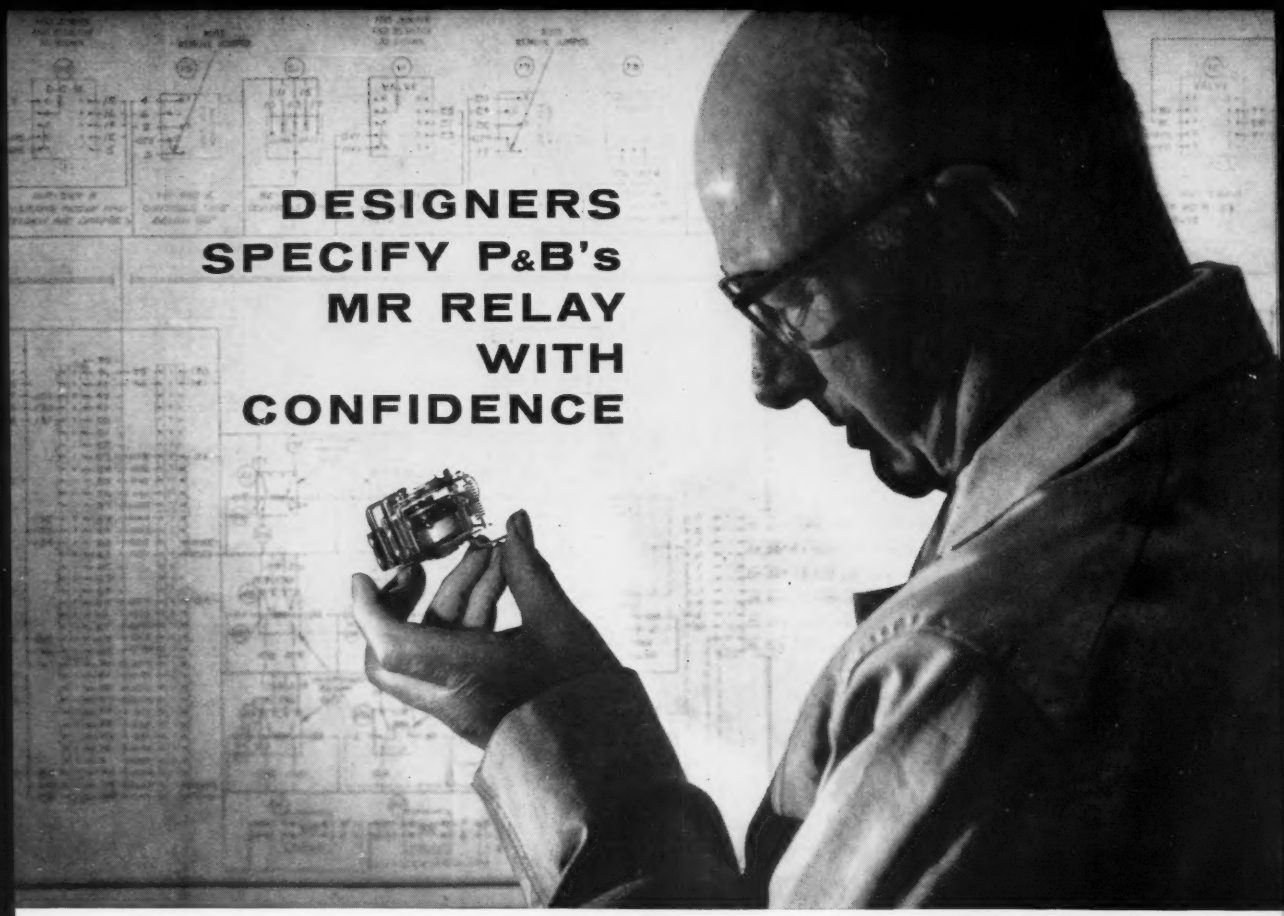
For all your plastic component requirements, call on GeMex experts . . . the G.M. Plastic Technical Group. They can help you with any vacuum forming problem in plastic.

CANADA'S LARGEST PRODUCERS OF
VACUUM FORMED PARTS AND EXTRUDED SHEET

G.M. PLASTIC CORPORATION

G.M. PLASTIC CORPORATION
GRANBY QUEBEC • P.O. Box 548 • Telephone FRontenac 2-5457

Circle number 130 on time saver card



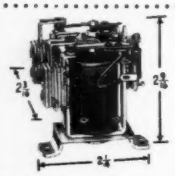
for a host of control applications

RELIABILITY coupled with low cost are two factors which place the MR series relays high on P&B's best seller list. They are being used in a multiplicity of designs . . . transmitters, street lighting equipment and small motor starters, to name but a few.

Both AC and DC models are available, with AC coils ranging up to 440 volts. All are adaptable for printed circuit mounting. The wide variety of contact arrangements include:

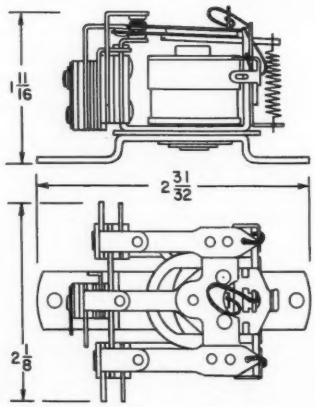
SPST-NO	SPST-NC-DB	DPST-NC	3PST-NC
SPST-NC	SPDT	DPDT	3PDT
SPST-NO-DB	DPST-NO	3PST-NO	

For more information about this medium duty, compact relay, call or write today—or get in touch with the P&B sales engineer nearest you. See our complete catalog in Sweet's Product Design File.



LM SERIES: Plate circuit relays similar to the MR. All sp and dp contact arrangements shown above are available. Coils are wound to specified resistances up to 58,000 ohms max. Sensitivity ranges from 15 mw min. (single pole) to 70 mw min. (double pole).

MR SERIES



GENERAL SPECIFICATIONS:

Breakdown: 1500 volts, 60 cycle rms between all elements.

Temperature Range:
DC —55°C. to +85°C.
AC —55°C. to +75°C.

Pull-in: Approx. 75% of nominal dc voltage; 78% of nominal ac voltage.

Weight: 4 ozs.

Dimensions: 2 31/32" long x 2 3/16" wide x 2" high.

Mounting: Two 9/32" dia. holes. Can be adapted for printed circuits.

CONTACTS:

Arrangements: Up to 3pdt.

Material: 7/32" dia. silver. (Others available).

Load: 8 amps @ 115 volts, 60 cycle, resistive.

COIL:

Max. Resistance: 34,500 ohms.

Power: 1.5 watts dc; 3.25 volt-amps ac. Will withstand up to 6 watts at 25°C.

Voltages: Up to 110 volts dc; up to 440 volts 60 cycle ac.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD CANADA LTD.

GUELPH, ONTARIO

Circle number 141 on time saver card

WHY ARE SO MANY SCHOOL SEATS MADE OF vibramix?

Because VIBRAMIX has proved virtually child-proof . . . AND this — you will admit — is test enough for any product, let alone school furniture.

Other reasons are the big savings effected with VIBRAMIX as a molding compound . . . as a faithful reproduction which eliminates machining . . . often as a one-unit solution to complex multi-piece assemblies . . . and always as an end product without weak spots.

Amazing VIBRAMIX is a polyester molding compound with reinforcing filler such as glass fibre or asbestos, in any colour you wish. It readily obeys medium pressures and heats, by standard compression or transfer molding.

You may find it very profitable to learn all about VIBRAMIX. Enquire, too, about Naugatuck's full line of resins for 'custom' mixing on your premises. For complete information or technical assistance, contact Naugatuck Chemicals at Elmira, Ontario, or our branches in Montreal, Toronto, Winnipeg or Vancouver.

OTHER SPECIAL FEATURES: Good heat and dimensional stability • excellent electrical properties • no glass preforming, resin mixing, preheating or post-curing • short molding cycles.

OTHER NAUGATUCK PRODUCTS

VIBRIN - MARVINOL
KRALASTIC
AND RESINS FOR PREMIXES

Naugatuck Chemicals

DIVISION OF DOMINION RUBBER COMPANY LIMITED

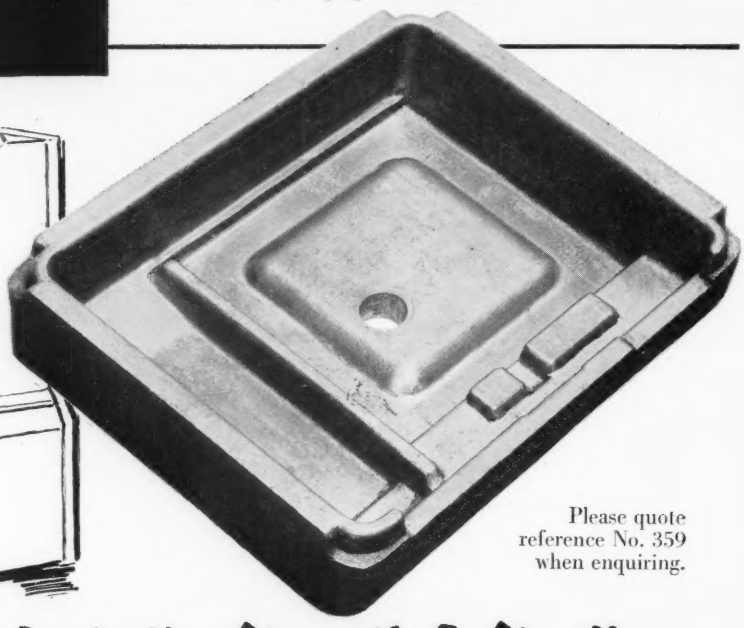
Circle number 124 on time saver card

STELCO

DROP FORGINGS

information

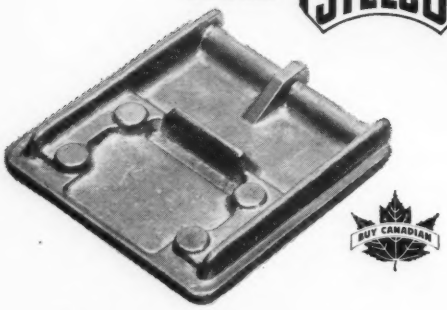
Send your request for regular mailings of the Stelco bulletin "Drop Forgings Information."



Please quote reference No. 359 when enquiring.

Coin Boxes Gain Protective Strength & Sturdiness

from STELCO DROP FORGING



The front housing and door blank parts illustrated in the photographs above were developed to provide the required strength and durability for telephone coin boxes.

Wherever strength and durability are important the possible use of Drop Forgings should be carefully examined.

Forging uses only prime quality steel which is toughened as the process compresses its grain structure. Properly designed forging dies produce the part with unbroken grain-flow lines, thus materially improving its ability to withstand stress.

Economies, either from reduced production cost or from increased durability, are usually realized.

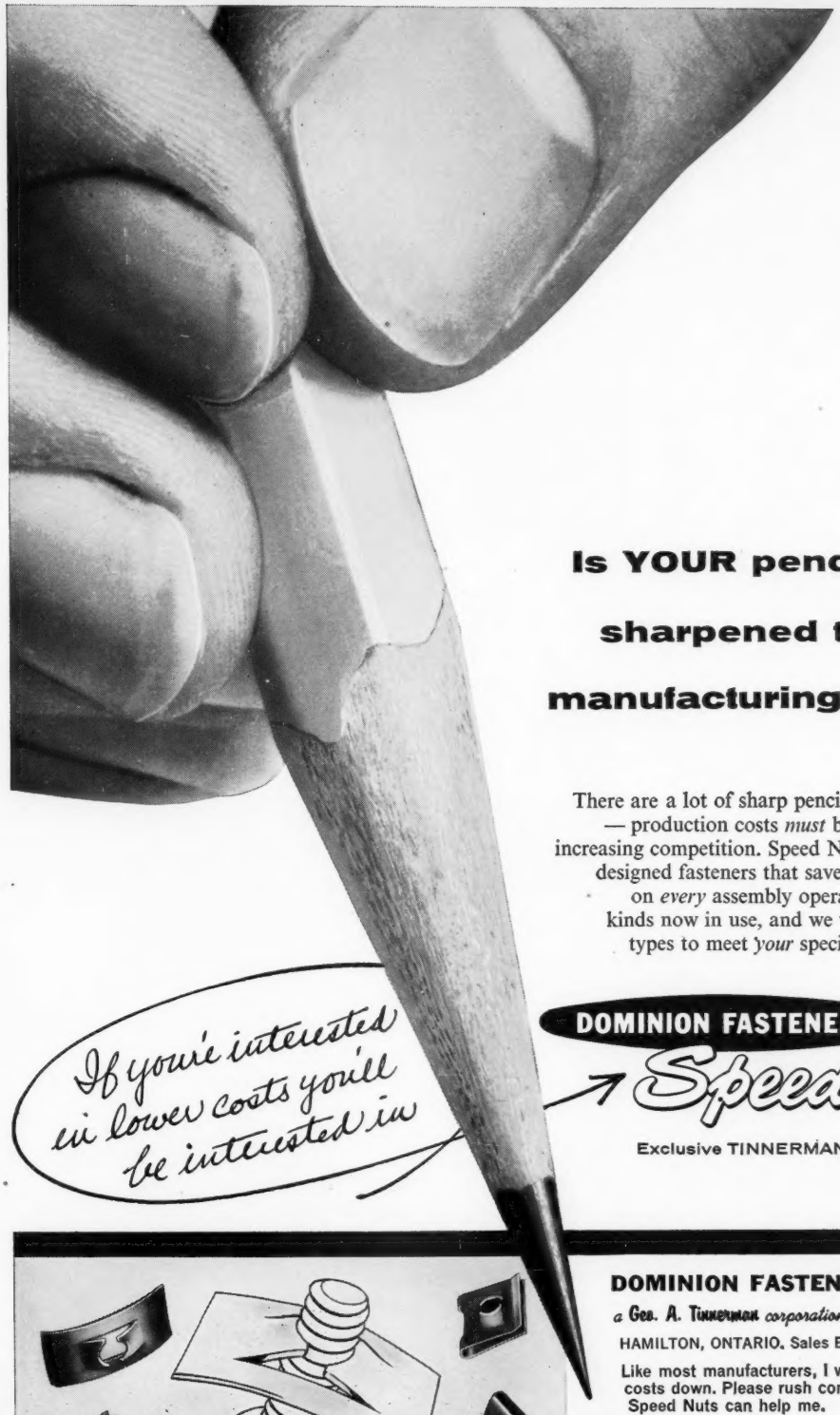
Contact Stelco's Forging Engineers for co-operation at the design level on custom-made parts or components.

THE STEEL COMPANY OF CANADA, LIMITED

Drop Forge Division, Gananoque, Ontario

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland. 59302.B

Circle number 148 on time saver card



Is YOUR pencil sharpened to reduce manufacturing costs?

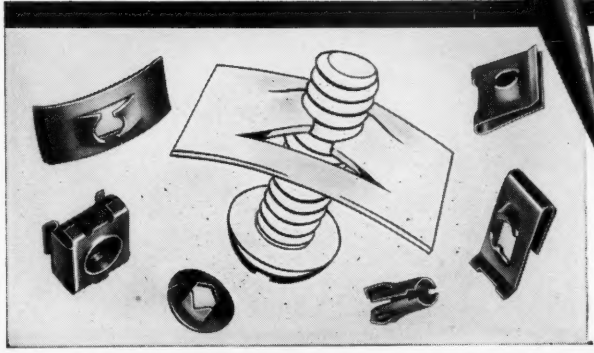
There are a lot of sharp pencils in use these days — production costs *must* be kept in line to meet increasing competition. Speed Nuts are specially designed fasteners that save time and money on *every* assembly operation. There are 8,000 kinds now in use, and we will gladly design types to meet *your* special needs.

If you're interested in lower costs you'll be interested in

DOMINION FASTENERS

Speed Nuts®

Exclusive TINNERMAN Canadian Licencee



DOMINION FASTENERS LIMITED

a Geo. A. Tinnerman corporation

HAMILTON, ONTARIO. Sales Branches: Toronto, Montreal

Like most manufacturers, I want to get my production costs down. Please rush complete information on how Speed Nuts can help me.

NAME_____

COMPANY_____

ADDRESS_____

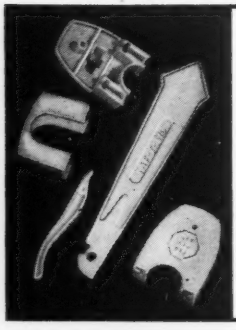
WE MANUFACTURE_____

Circle number 123 on time saver card

Fortilene† for fun!

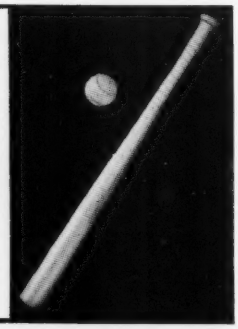
Scepter-Spinner
A sensational new toy for amateur jugglers. So easy to spin, and so much fun. Made of unbreakable Fortilene by Scepter Manufacturing Co. Ltd.

Hockey Pads
Made to withstand the toughest treatment. Their high impact strength gives ideal protection. Made of Fortilene, by Trans Canada Plastics Ltd.



Bicycle Directional Signals
Designed to ensure safety—sturdily built to last as long as the bicycle. Another Fortilene application by Plastene Co. for M.R.F. Enterprises.

Baseball and Bat
Regulation size! An ideal lightweight baseball set that can't hurt the kiddies! This durable "Lido Champ" is merchandised by Lido (Canada) Reg'd.



Nothing beats the durability and attractive appearance of toys and sporting goods made of Fortilene. This plastic is extra tough, rigid, and resistant to chemicals; it has high impact strength, and good weathering characteristics.

FORTILENE could be best for your plastic application – contact:

CANADIAN CHEMICAL COMPANY, LIMITED
MONTREAL • TORONTO • VANCOUVER

†Reg'd. Can. Trademark.

Chemcell® PLASTICS

Circle number 115 on time saver card

More reasons why OEM designers specify

THE BELLOWS AIR MOTOR

—the air cylinder with the built-in valve

- **no extra valves—all operating controls are built-in**
- **choice of valve types: low voltage, JIC, pilot-actuated, mechanically actuated**
- **responds to starting impulse instantly—no lag, no stutter**
- **fits well in tight quarters, on moving machine elements**
- **no cumbersome piping, requires only a single air connection**
- **available in five bore sizes: 1¼, 1¾, 2½, 3⅝, 4½"**
- **made in any stroke length**
- **over 150 skilled field engineers the world over to handle your fluid power requirements.**

They all add up to:

LESS DESIGN TIME REQUIRED,
LOWER FACTORY COST TO INSTALL!

Get this Booklet!

"The Bellows Air Motor in Original Equipment Design." Write Dept. DE-659, The Bellows Co., Akron 9, Ohio.

Bellows
PNEUMATIC DEVICES OF CANADA, LTD.
14 ADVANCE ROAD TORONTO, CANADA

1221-B

Circle number 108 on time saver card

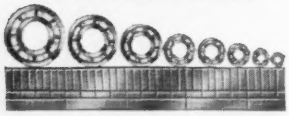
THE LYMAN LINE OF LEADERS

TUBING

Seamless Mechanical Hydraulic Stainless Steel
Boiler Condenser Aircraft

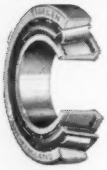
In various diameters and thicknesses ⅛" — 10½" incl. FROM STOCK — Small Diameter tubing .203" OD to .008" OD.

MIRACLES IN MINIATURIZATION



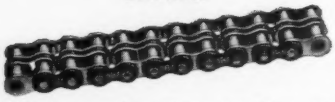
Miniature Precision Bearings made from ⅜" OD down. Over 500 types and sizes in stock.

TIMKEN TAPERED ROLLER BEARINGS



Made in England by British Timken Ltd. Lyman engineers are available to help on designs, development or production problems. Complete stocks.

A.S.A. BRILLANT ROLLER CHAINS

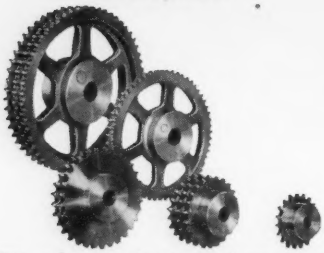


This is a quality Chain. Made in all standard sizes from #35 to #200 in Single, Double and Triple widths. Complete stocks coast to coast. Also Standard Attachments.

HOFFMANN BALL & ROLLER BEARINGS

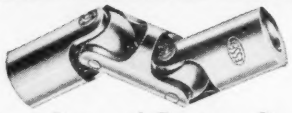
Immediate deliveries from complete stocks. Over 100 types in sizes from ¼" bore up.

SPROCKETS



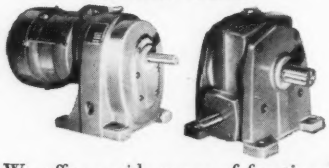
We stock a wide range of sprockets to fit all sizes of A.S.A. Roller Chains. #35 to #200. Can supply any style of hub, A.B. or C.

ESSEX UNIVERSAL JOINTS



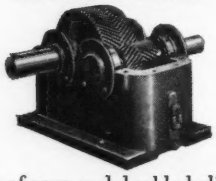
Heavy Duty and Precision Single and Double Type Universal Joints from stock. Also joints made of special materials, for marine and particular applications.

MOTOR GEAR



We offer a wide range of fractional and medium H.P. Spur and Worm reduction gear units, with or without motors. Hi-ratio spur reduction gear adaptor to enable overall ratios as high as 1200: 1. Delivery from stock.

REDUCER UNITS



A line of spur and double helical reduction units with parallel and right angled shafts and different combinations. This is a heavy duty line up to 6000 H.P. ratings and high ratios.

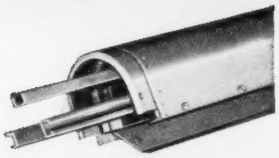
FOR PROTECTION UNDERFOOT!

MORTON KASS SAFETY TREAD

for Floors, Steps, Ramps, Platforms. Grips more surely. Renews grip by wear.

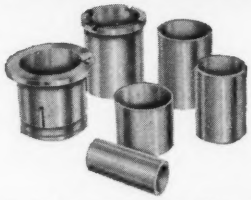
Circle number 136 on time saver card

KEYSTONE INTEGRATED ALUMINUM CONDUCTOR SYSTEMS



The most complete modern system high current capacity with minimum voltage drop.

JOHNSON BEARINGS



Self Lubricating — Cast Bronze — Graphited Bronze, etc. Stocks of General Purpose bearings ¼" to 4½" ID and Ledaloyl self-lubricating bearings ⅛"—4" ID are immediately available from stock in Montreal, Toronto and Winnipeg.

WALDES TRUARC RETAINING RINGS

Whatever you make, there is a WALDES TRUARC Retaining Ring designed to save material, machinery and labour costs. Precision engineered, quick and easy to assemble, always circular to give a never failing grip. Thousands of sizes in stock from .010" thick upwards.

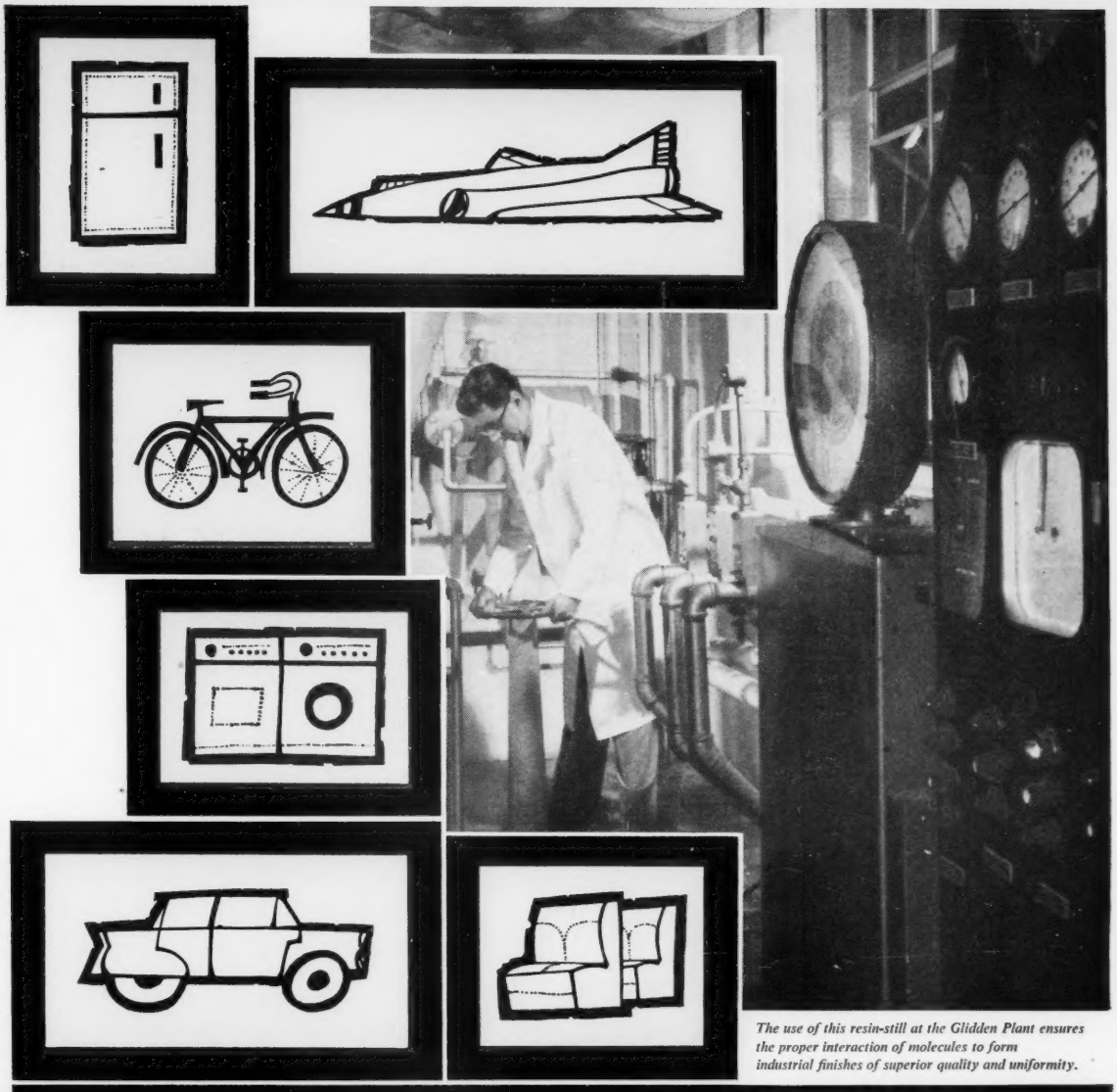
SUPERFECT OIL SEALS

Complete stocks of SuPerfect Oil Seals ¾" OD to 11" OD in Chrome tanned leather, Supertan leather, Pretan leather and Synthetic rubber are carried in stock at all Lyman warehouses.

Write for details and catalogues covering product in which you are interested.

LYMAN TUBE AND BEARINGS, LIMITED

MONTREAL TORONTO
HAMILTON LONDON
WINNIPEG VANCOUVER NEW GLASGOW, N.S.



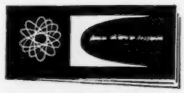
The use of this resin-still at the Glidden Plant ensures the proper interaction of molecules to form industrial finishes of superior quality and uniformity.

GLIDDEN SOLVES NEW FINISHING PROBLEMS EVERY DAY

QUALITY Glidden PRODUCTS

How well will your product's finish stand up in the middle of the Sahara . . . or Canada's Arctic? If it is a Glidden finish, you already know. You know because Glidden provides complete test data with every finish designed and recommended for a specific job. Whether you manufacture a high-altitude, super-sonic aircraft or a bicycle to take the abuse that only a child can give, Glidden will formulate and thoroughly pre-test a finish for your particular application.

The Glidden Technical Service Department possesses the most modern finish-development and testing equipment available. Its facilities are at your disposal.



INFORMATION YOU'LL VALUE!
This booklet outlines Glidden Technical and Laboratory Services—and how you can profit by them. We will gladly send a free copy to plant executives on request. Just write to:

THE GLIDDEN COMPANY LIMITED

Technical Service Department • 351 Wallace Ave., Toronto, Ont. • 133 Elmslie St., Ville La Salle, Montreal, P.Q.

Circle number 129 on time saver card

DU PONT CANADA

PRODUCT ENGINEERING NEWS

TYPICAL APPLICATIONS OF MOULDED NYLON

Moulded Nylon Now Used by Leading Water Pump Manufacturers in Nozzles, Impellers, Valve Plates and other Components

Pump Producers Find Moulded Nylon Outlasts Metal — Increases Efficiency and Reduces Costs

A current manufacturing trend indicates that nylon may soon be found as frequently in pumps as it is now in countless products, ranging from textiles to tires.

Some of Canada's leading pump manufacturers are switching from metal to moulded nylon in a variety of pump parts, and discovering that, in making the switch, they get substantial cost reductions and higher efficiency.

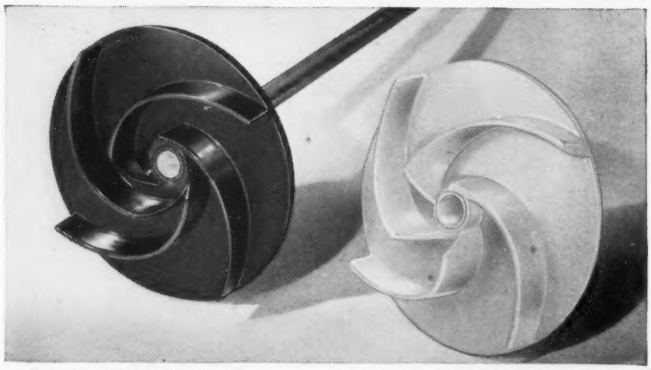
Parts in which nylon has been replacing metal are venturi tubes, nozzles and impellers in jet pumps; impellers in sump pumps; valve plates in piston pumps; and nylon linkage-tubing in various types of water pumps. Success so far has stimulated manufacturers to experiment with other components moulded of nylon.

Such firms as S. A. Armstrong Limited, Toronto; Canadian Fairbanks-Morse Company Limited, Montreal; Otaco Limited, Orillia, Ont.; Pumps and Softeners Limited, London, Ont., are now using the moulded parts.

Since water pumps are essential in country homes, motels, summer cottages, farms and other buildings in areas not serviced by city water mains, the cost-efficiency factor here is of direct benefit to thousands of Canadians.

Pumps producers report that among the advantages of the moulded nylon are rust-proofness, light weight and the smoothness of its surface which reduces abrasion and friction, permitting greater output by the pump. This is particularly significant, for instance, in farms where silt-bearing water erodes metal surfaces, and metallic water content in wells tends to corrode or scale the metal. These conditions leave the nylon practically unaffected.

One measure of this effectiveness was found in a nylon impeller introduced into a sump pump by *Fairbanks-Morse*. The one-third horsepower motor, when equipped with a brass impeller, could evacuate water at a rate of 3,800 gallons an hour. Substitution of a nylon impeller in this sump pump increased the output to 4,200 gallons an hour. The nylon impeller now is found in deep and shallow well pumps and in both submersible and above-ground sump pumps produced by this company. Nylon tubing is also being used with increasing frequency.



These moulded nylon impellers are used in Canadian Fairbanks-Morse sump pumps. This type of nylon impeller increased pump evacuation capacity from 3,800 to 4,200 gallons an hour.

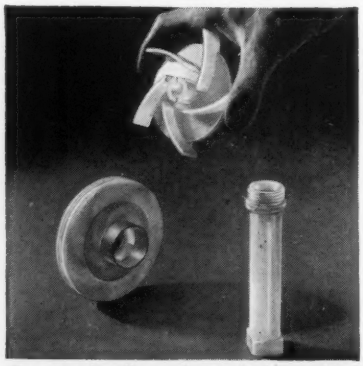
For its piston-type pump, Canadian Fairbanks-Morse uses a valve plate moulded for it by CANADIAN GENERAL ELECTRIC COMPANY, Cobourg, Ont.

Otaco Limited is another Canadian pump manufacturer using "Zytel" for impellers and venturi tubes, jet nozzles and nylon tubing. It has reported as much as 17 per cent increase in efficiency as a result. These parts are moulded by TORONTO PLASTICS LIMITED.

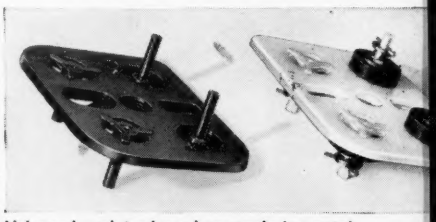
S. A. Armstrong Limited has replaced metal venturi tubes and nozzles in its shallow well pumps with nylon units, also moulded by Toronto Plastics. Spokesmen for the company report that the anti-abrasion effect of the "Zytel" provides longer life than machined castings. The unit cost was also reduced even in the early stages of production when the cost of the mould had to be included.

Pumps and Softeners Limited also uses moulded venturi tubes in its water pumps.

All of these parts are moulded in Canada from "Zytel" nylon resin, manufactured in Canada by Du Pont of Canada. The trend toward nylon components in pumps likely will continue. In addition to experiments testing its use in other parts of water pumps, investigations are going on to determine how it may be incorporated into pumps for such equipment as washing machines.



These two impellers and venturi tube, moulded of "Zytel" nylon resin by Toronto Plastics Limited, are rust-proof and light weight, with lower friction and abrasion characteristics than similar metal parts.



Nylon valve plates have been replacing metal units in piston pumps.

Versatile moulded nylon is producing cost reductions, better performances and increased efficiency for hundreds of Canadian and American manufacturers. Let it do the same for you. Contact your moulder, or call a Du Pont Sales Engineer. You will not be under any obligation.

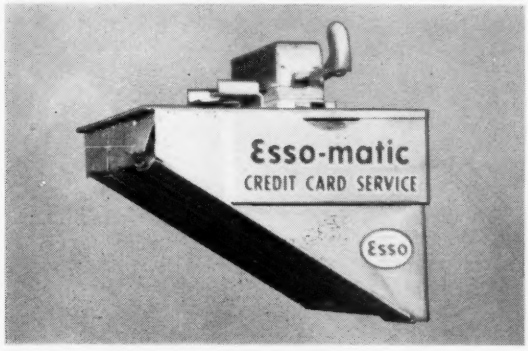
DU PONT OF CANADA LIMITED
CHEMICALS DEPARTMENT
P.O. Box 660, Room A-4, MONTREAL, QUE.

Circle number 125 on time saver card

ATLAS steels solved these metal problems

Cutter blades on dredge suction head interlaced with high strength Atlas SPS-245 Machinery Steel bars overcame problem of rocks and boulders entering suction pipe and damaging pumping equipment.

Switching to Atlas type 301 stainless for concave cap sections on cupboard door knobs solved 30% reject problem caused by plating solution leakage in original product.



For long-life, corrosion-free service, type 302 stainless steel was used for outdoor service station charge plate mounting units. It replaced plated steel, which failed because of rust and wear after only four years of service.

The Atlas Crodi Tool Steel master hob (right) was used to pressure cast cavity dies in berryllium copper for plastic toy truck box. The impression, with deep reinforcement ribs left as cast, cut labour cost 30% over normal machining.

what's *your* METAL PROBLEM?

Atlas can help you . . . with Tool Steels, High Speed Steels, Mining Drill Steels, Special Purpose Steels, Machinery Steels, Heat Resisting Steels, Electrical Alloys and Stainless Steels. Producing over 200 types of specialty steels, Atlas has built a fund of knowledge by continual close contact with all phases of Canadian industry that can help you solve your metal problems. Your local Atlas representative will put this knowledge to work for you immediately. Where extensive investigation is required, Atlas Service Metallurgy will be placed at your disposal on an obligation-free basis.

STRENGTH?
WEAR?
CORROSION?
FATIGUE?
WEIGHT?
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EROSION?
DESIGN?
FABRICATION?
METALLURGY?

If you have a metal problem call Atlas today.

ATLAS STEELS

Atlas specialty steels are produced in Welland, Ontario in electric arc furnaces which afford maximum quality control of both physical and metallurgical properties.

ATLAS STEELS LIMITED
WELLAND ONTARIO
Warehouses: Montreal, Toronto, Hamilton, Windsor, Winnipeg, Vancouver
Representatives: London, St. Catharines, Sudbury

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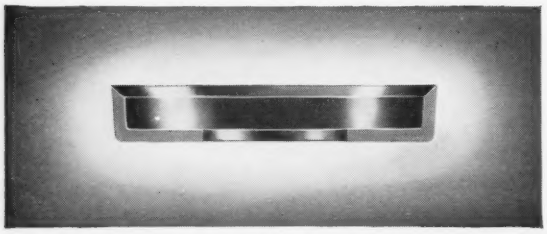
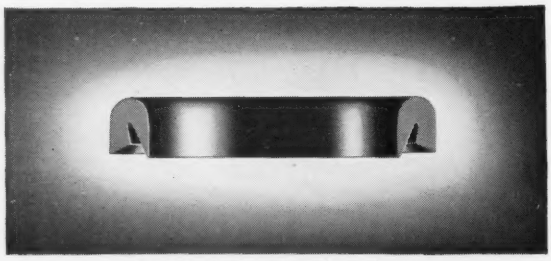
Simplify your sealing problems...

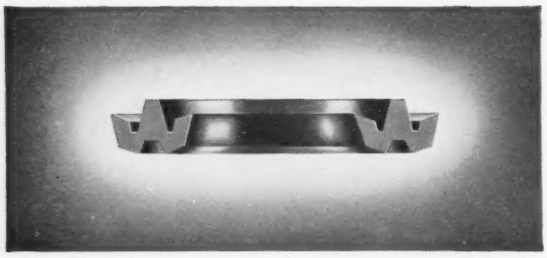
with Johns-Manville Precision moulded packing designs for pressure applications in hydraulic and pneumatic equipment



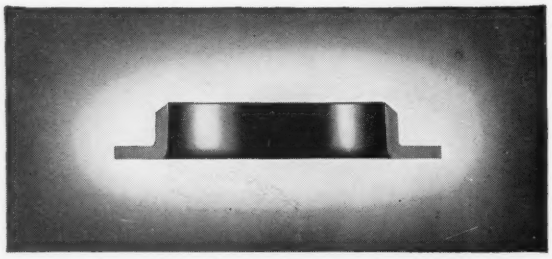
1. Type "A" Packing Cups for pistons
(the original "square heel" cup design)



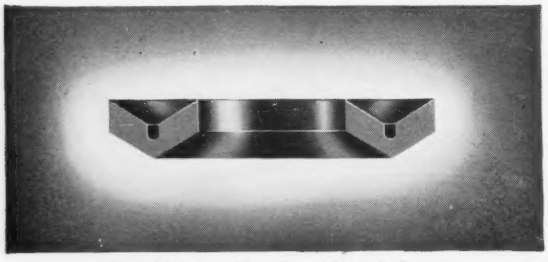
2. Sea Ring packing for rods



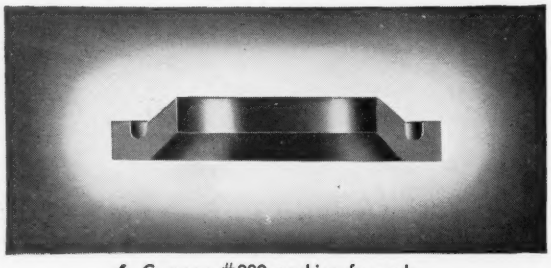
3. Uneepac Packing for rods and pistons



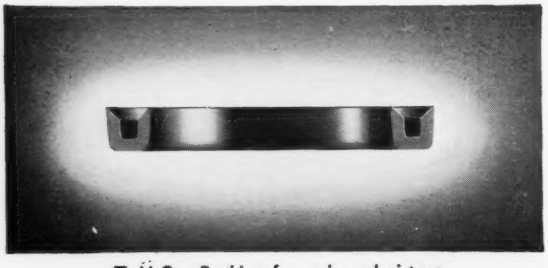
4. Hat Cup Packing for rods



5. V-Rings packing for rods and pistons



6. Cumpac #239 packing for rods



7. U-Cup Packing for rods and pistons

THE WIDE VARIETY of Johns-Manville Packing designs enables you to handle practically any sealing problem. The designs shown on this page are obtainable in a broad range of standard sizes and in materials designed for either usual or special service conditions encountered in hydraulic and pneumatic equipment. Johns-Manville also produces oil seals, moulded gaskets and miscellaneous shapes to specification. See your local J-M distributor or J-M sales office for product or engineering data. Or write Canadian Johns-Manville, 565 Lakeshore Road East, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville MOULDED PACKINGS

1-1061

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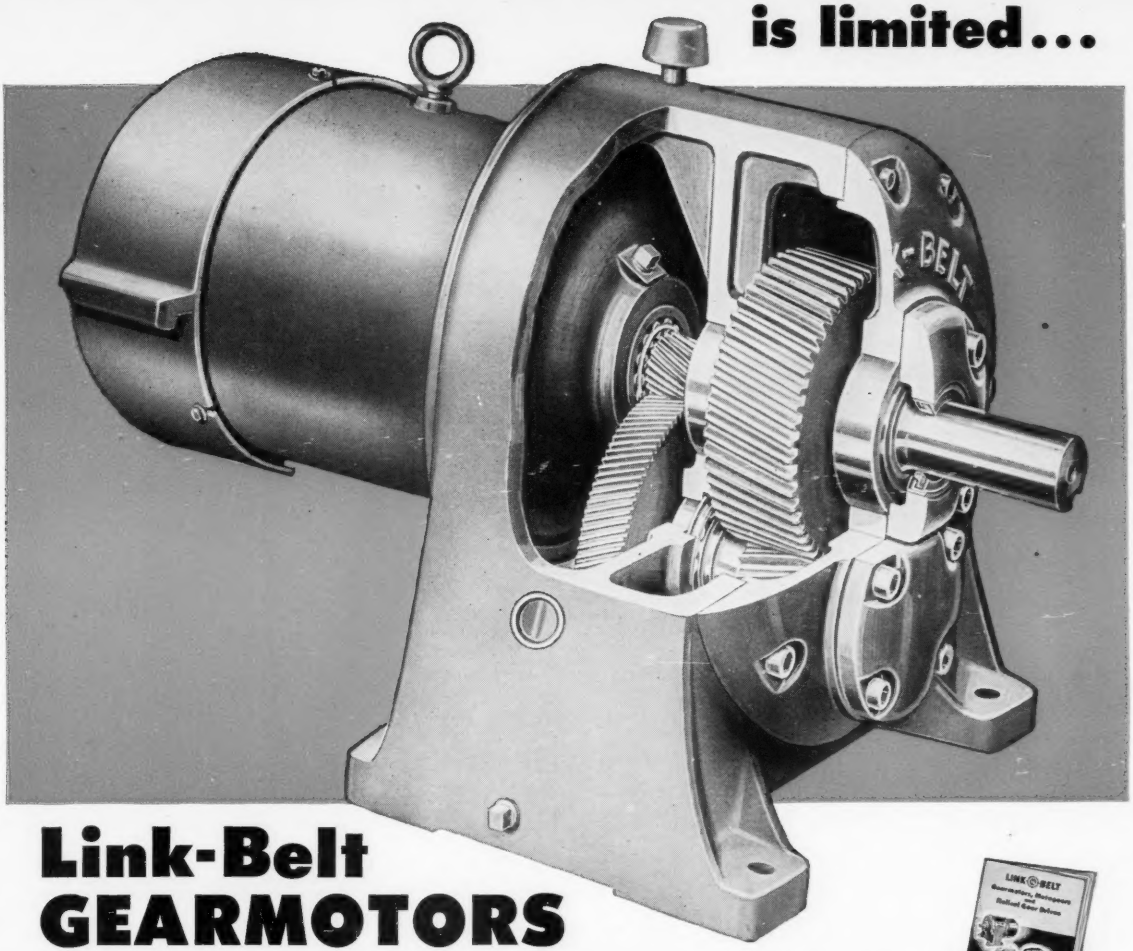
Efficient speed reduction where space is limited...



Link-Belt GEARMOTORS

With their integrally-mounted CEMA electric motors, Link-Belt Gearmotors are your economical answer to efficient speed reduction in minimum space. And to assure years of trouble-free service, they're built better these ways:

BUILT-IN ALIGNMENT of motors and gears results in lasting efficiency plus maximum safety. **HOBBED HELICAL GEARS** are rigidly mounted for smooth, quiet action. Pinions are heat-treated chrome-moly steel.

SHAFTS are precision machined and ground. **ANTI-FRICTION BEARINGS** withstand heavy loads.

AUTOMATIC SPLASH LUBRICATION system reliably supplies oil to all moving parts. **MAGNETIC DRAIN PLUG** removes ferrous particles from lubricant.

BUILT-IN POSITIVE BACK-STOP is available on all units.

LINK-BELT GEARMOTORS are designed to meet the most demanding operating conditions. And they're stocked in various horsepowers and ratios for immediate shipment from your nearest Link-Belt factory branch store. For details, contact your representative.

FOR MORE FACTS ON GEARMOTORS WRITE FOR BOOK 2247

LINK-BELT

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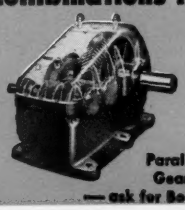
LINK-BELT LIMITED: Scarboro Plant, General Offices and District Sales—Dept. 759-DE, Scarboro, Ont., Station H, Toronto 13 • Eastern Avenue Plant and Factory Branch Store—Toronto 8 • Sales Offices and Factory Branch Stores—Montreal 15 • Vancouver 12 • Winnipeg 10 • Swastika, Ont. • Halifax: Austen Bros. Ltd. • District Sales Offices—Hamilton • Edmonton • Sydney: Austen Bros. Ltd. • Foundry at Elmira, Ont. 14,006

Get JOB-MATED drive combinations from the complete Link-Belt line

In addition to all three types of enclosed gear drives, Link-Belt builds variable speed drives, fluid drives, chains, sprockets, couplings, bearings, shafting, etc. All are pre-engineered for easy installation and maximum efficiency.

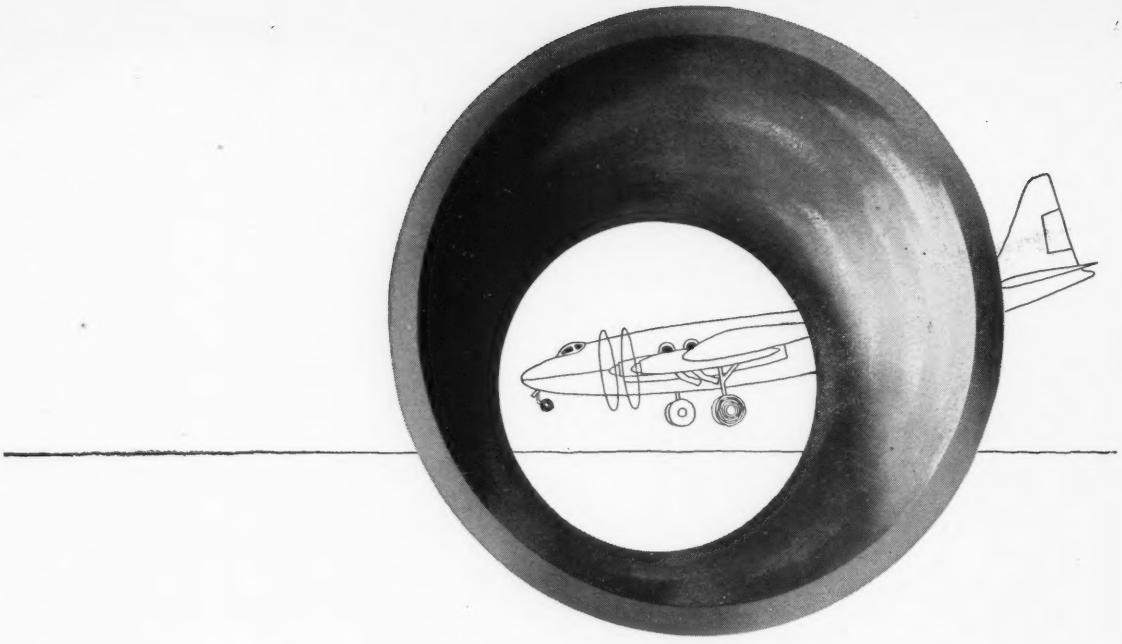


Parallel Shaft Gear Drives — ask for Book 2619

Worm Gear Drives — ask for Book 2324-A

Helical Gear Drives — ask for Book 2451

Circle number 135 on time saver card



WHAT'S IN A TUBE?

Michelangelo could look at a block of marble and see an angel. What you see in a Chesterfield tube will depend on what you want to make. If for example, it calls for a cold drawn seamless steel roller tube up to 24″ internal diameter and manufactured to special close tolerances of ovality, thickness, eccentricity and straightness or a stainless steel extruded section for the aircraft industry—it will pay you to get in touch with ***chesterfield tubes***

THE CHESTERFIELD TUBE COMPANY LIMITED · CHESTERFIELD · ENGLAND · A (TI) COMPANY

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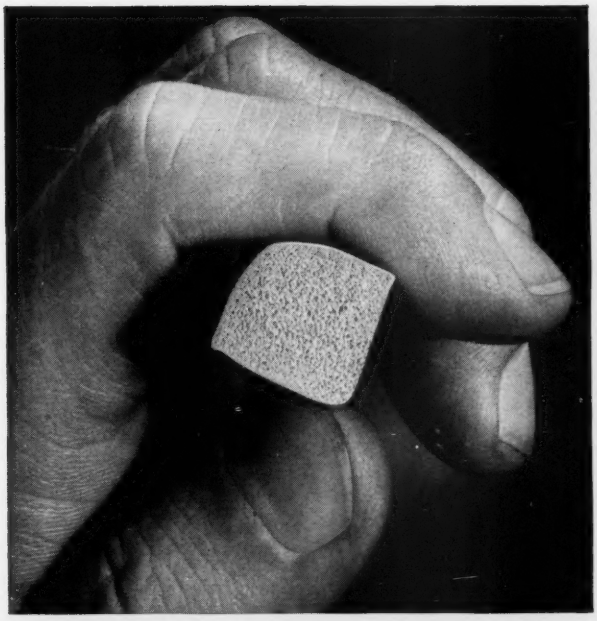
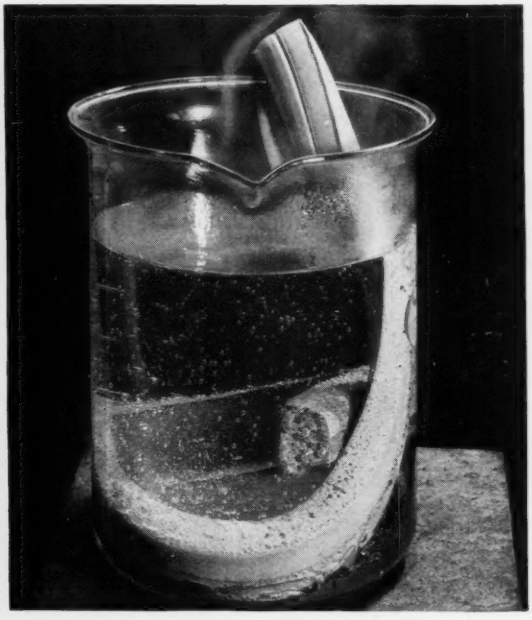
CRC62

Circle number 118 on time saver card

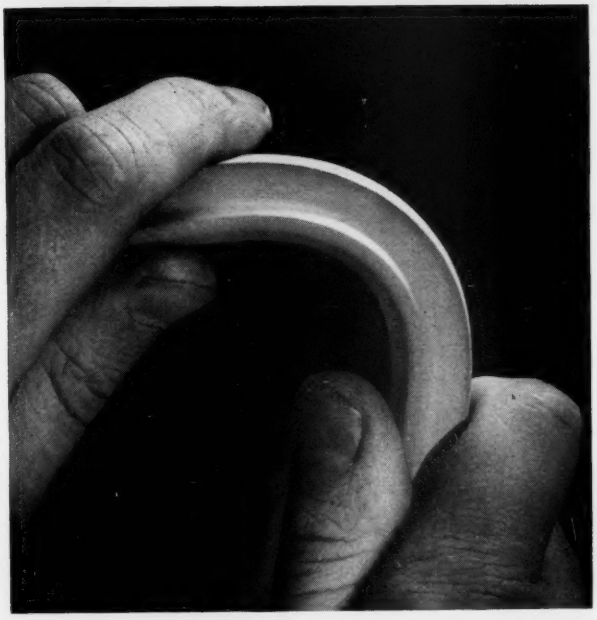
Extruded closed cell neoprene sponge makes better appliance gaskets

Gasketing material of closed cell neoprene sponge is helping solve some of the major problems in appliance sealing. Made of a non-absorbent sponge body and thin, tough neoprene outer skin, this sealing material performs well under the most severe conditions. Manufacturers' acceptance tests show that it can take hot water, detergents, cooking oils and food chemicals without harm. This gasketing material also has excellent resistance to abrasion, ozone and natural aging. If you design or manufacture an appliance or assembly involving a compressible seal, you will want more details. Write to Du Pont of Canada Limited, Room 400, 85 Eglinton Avenue East, Toronto, Ontario.





Above—Acceptance tests on neoprene sponge were run for 100 hours in water at 212°F., food fats and detergents at 180°F. Results showed less than 10% swell, low water absorption, no damage to sealing properties.



Upper left—Tough neoprene skin on extruded gasket resists abrasion, ozone, natural aging—won't chip, crack or peel. Closed cell neoprene sponge retains its compressibility and sealing pressure.

Left—Neoprene sponge gasket can be bent around sharp radii without wrinkling. Sharp corners can be cut and cemented; closed cell sponge structure is non-absorbent.

DU PONT CANADA

Better Things for Better Living . . . *through Chemistry*

SYNTHETIC RUBBER

NEOPRENE
HYPALON®
VITON*
ADIPRENE®

**Trademark for Du Pont Synthetic Rubber*

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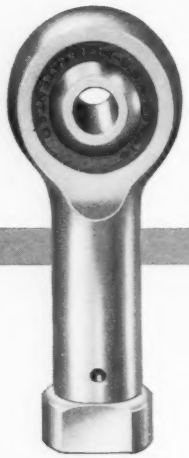
It's What's Up Front in ORBIT!

HEIM *Unibal*®

SPHERICAL BEARING ROD ENDS

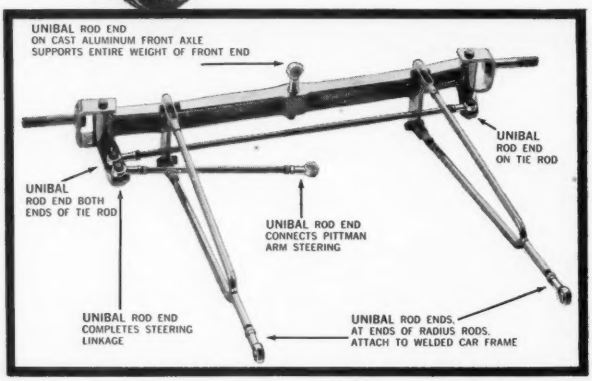


All seven of them . . . carry the weight and complete all linkages in the "Orbit Seven" Quarter midget Racer

The "Orbit Seven" was designed and is built by The Orbit Midget Mfg. Co., 400 Surf Ave., Stratford, Conn.

Unibal is the Spherical Bearing which . . .

- **Reduces friction and lost motion in linkages.**
- **Minimizes the effects of vibration.**
- **Are more economical than specially made parts.**
- **Carry heavier loads.**
- **Correct mal-alignment in all directions.**
- **Are easy to assemble and help to reduce costs.**


UNIBAL ROD END ON CAST ALUMINUM FRONT AXLE SUPPORTS ENTIRE WEIGHT OF FRONT END
UNIBAL ROD END ON TIE ROD
UNIBAL ROD END BOTH ENDS OF TIE ROD
UNIBAL ROD END CONNECTS PITTMAN ARM STEERING
UNIBAL ROD END COMPLETES STEERING LINKAGE
UNIBAL ROD ENDS AT ENDS OF RADIUS RODS ATTACH TO WELDED CAR FRAME

Engineered for the safety of its young drivers, the "Orbit Seven" Quarter Midget Racer uses Unibal Rod Ends at both ends of the tie rod, at both ends of the steering rod, at the rear ends of the radius rods where they connect to the frame, and in the center of the front axle to support the front end and permit fully adjustable caster and axle setting for any track conditions.

This demonstration of the versatility of the Unibal Rod End will suggest other possibilities to the design engineer. Note that, although referred to universally as a "rod end", Unibal also serves as a self-aligning support, as well as linkage terminals.

R&M BEARINGS CANADA LTD.

QUEBEC CITY	MONTREAL	WINNIPEG	THREE RIVERS	TORONTO	VANCOUVER	LONDON, ONT.	HAMILTON
755 Blvd. des Capucins	1006 Mountain St.	1302 Notre Dame Ave.	375 St. Georges St.	338 50 Edward St.	1066 Seymour St.	1024 Oxford St. East	130 Ferguson Ave. N.

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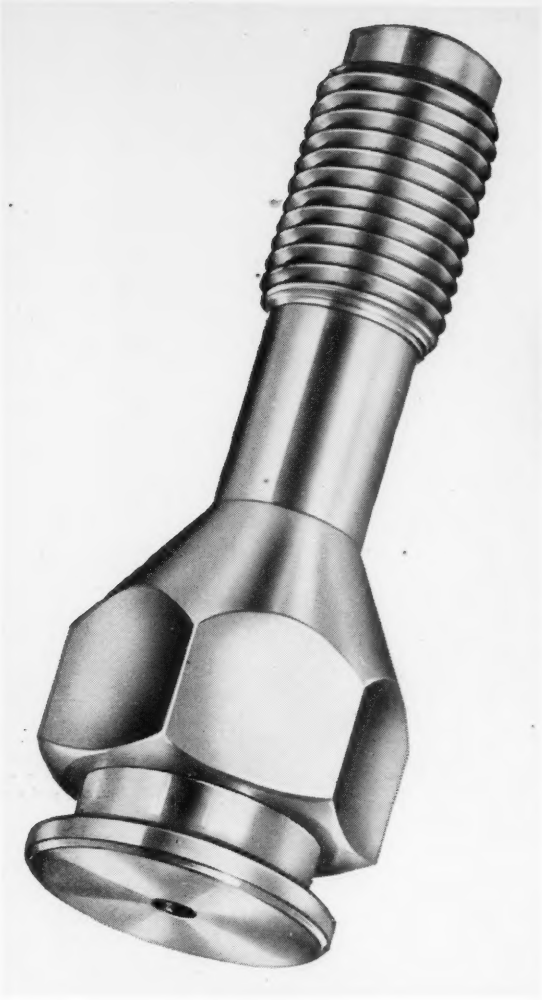


CUT PRODUCTION COSTS!

Here is an excellent example of how a leading Canadian Manufacturer reduced his overall production costs by having certain components made by the Screw Machine Division of the Weatherhead Company. The manufacturer not only saved money on the components but also valuable man hours and machine time. Production of the project was therefore accelerated—result, greater production, lower overall cost.

Weatherhead produces thousands of precision-made components, such as this, in the million quantities, for Canada's major manufacturing industries. Our manufacturing "know-how" in producing components made from brass, steel, aluminum, nylon and other materials may change the profit picture of your end product.

Our sales representative can tell you how economically we can produce any quantity, small or large. We welcome your enquiry. Send in blueprints, specifications or samples for quotation. Address your enquiries to Dept. SM, The Weatherhead Company of Canada Ltd., St. Thomas, Ontario.

THE MARK OF QUALITY

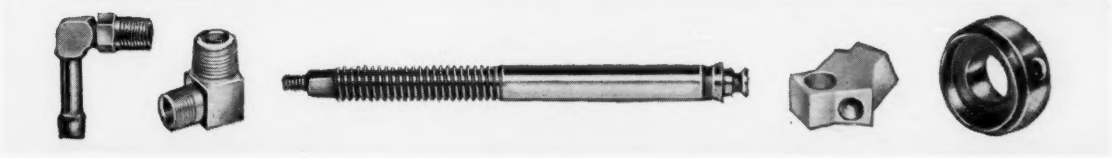
WEATHERHEAD

SCREW MACHINE DIVISION

St. Thomas, Ontario

Here are a few of thousands of parts produced for leading Canadian manufacturers.

SM-2-8-2C



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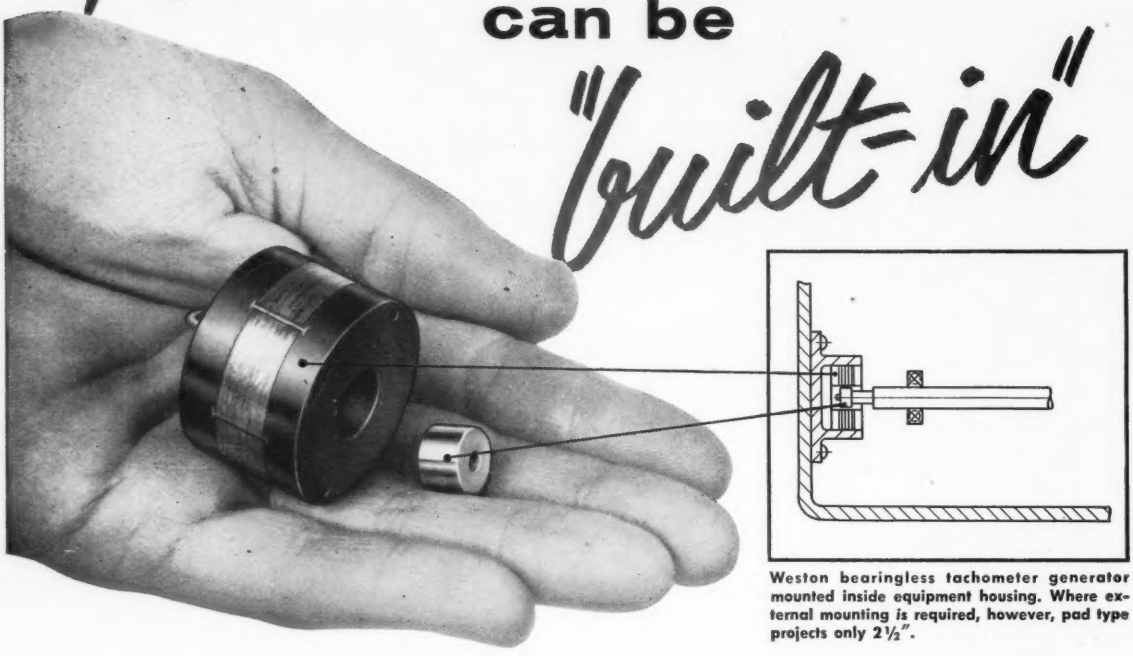
Now... The TACHOMETER GENERATOR can be "built-in"



Weston bearingless tachometer generator mounted inside equipment housing. Where external mounting is required, however, pad type projects only 2½".

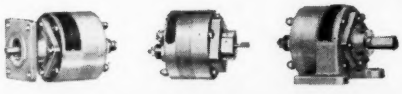
WESTON Bearingless Tachometers save Space...Weight...Cost!

With the Weston bearingless design, the tachometer generator can now be built-in, rather than attached to, rotary equipment. But where external mounting is essential the special pad housing projects only 2½". Either way, it means big **weight saving** and **space saving**; and lends itself to better overall design. Best of all, the compact rotor and stator are oil-resistant and virtually trouble-free . . . and initial costs are now 'way down.

Can be used with individual or duplicate and remote indicators, and with Weston recorders. Speed ranges, low as 500 and up to 80,000 rpm full scale. For the complete Weston Tachometer story, send for catalogue to-day. **Daystrom Limited, 840 Caledonia Road, Toronto, Ontario, 5430 Ferrier Street, Montreal, Que. A subsidiary of Daystrom, Incorporated, or any office of Northern Electric Co., Ltd.**

5715

Weston Indicators are available in required sizes and shapes, calibrated in any function of RPM.



Weston A-C and D-C Generators available in all external mounting types including explosion proof and heavy duty.

WESTON TACHOMETERS

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● We see no reason to keep under this reinforced plastic hat the fact that Reichhold sells a QUALITY LINE OF POLYESTER RESINS for every type of product and manufacturing procedure. For full information on RCI's versatile polyesters, clip and mail the check list below. Technical information will be sent to you promptly.

My Name is_____

I am_____
TITLE

of the company indicated on this letterhead.

Please send me full technical information on the use of RCI POLYLITE Polyester Resins for:

☐ Polyurethane Foams	☐ Laminating	☐ Matched Die Molding
☐ Surface Coating	☐ Casting	☐ Press Molding
☐ Corrugated and Flat Sheet	☐ Structural Lay-up	☐ Encapsulating

Creative Chemistry ... Your Partner in Progress

Synthetic Resins • Chemical Colors • Industrial Adhesives • Phenol
Hydrochloric Acid • Formaldehyde • Glycerine • Phthalic Anhydride
Maleic Anhydride • Sebacic Acid • Ortho-Phenylphenol • Sodium Sulfite
Pentaerythritol • Pentachlorophenol • Sodium Pentachlorophenate
Sulfuric Acid • Methanol

REICHHOLD

REICHHOLD CHEMICALS (CANADA), LTD.
1919 Wilson Ave., (Weston), Toronto 15, Ontario

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Announcing new . . .

DURACRON*

THERMO-SETTING ACRYLIC ENAMEL . . .

From Pittsburgh's Springdale Research Centre comes news of a distinctive new development in industrial enamels. Duracron Thermo-setting Acrylic Enamel is not merely another modification of an existing vehicle—it is a basically new chemical composition and a revolutionary departure from the baking enamels used today. Because of its unique properties Duracron is particularly suitable for the finishing of household appliances, air-conditioning units, metal furniture, partitioning, siding, tile and cabinets—in brief, any surface on which it is desirable to improve present baking enamels.

Only new Duracron offers you all these advantages over other baking enamels:

- Superior adhesion to bare metal or primer.
- Outstanding toughness, hardness, and impact resistance either as a one-coat enamel or over primer.
- Remarkable colour and gloss retention for prolonged periods.
- Greatly increased resistance to detergents.
- Will not show stains from grease, inks, fruits, mustard, ketchup, etc.
- Gives improved resistance to salt spray, humidity and other corrosive atmospheres.
- Provides a sanitary, taste-free, mar-proof liner for food cabinets.
- Retains film continuity under severe impact.
- Available in clear, white and a range of colours.

THE REVOLUTIONARY NEW ONE-COAT INDUSTRIAL ENAMEL

This Finish Started with Research

PITTSBURGH PAINTS

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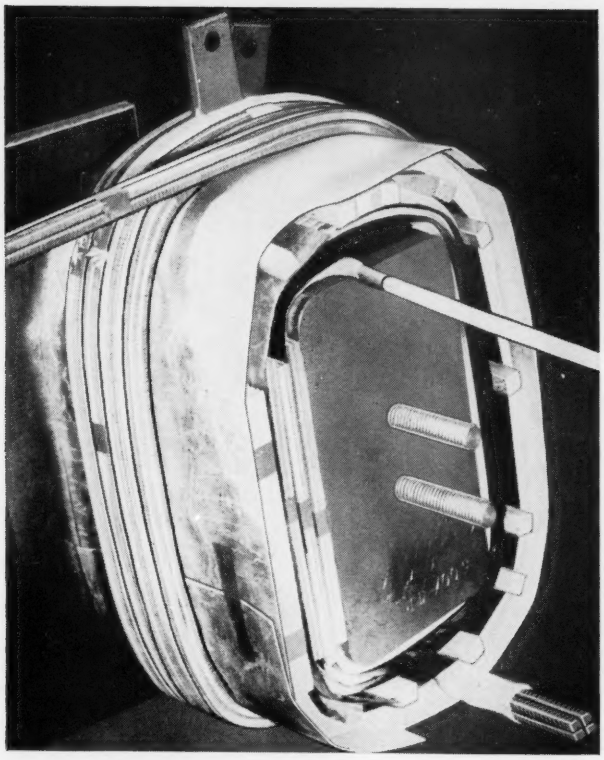
Circle number 117 on time saver card

lower production costs

on "Class B" and "Class F" windings with



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DAGLAS* MAGNET WIRE

Unique mechanical properties, such as extreme flexibility, resistance to abrasion and damage from forming, make Daglas magnet wire the ideal material for all "Class B" and "Class F" windings.

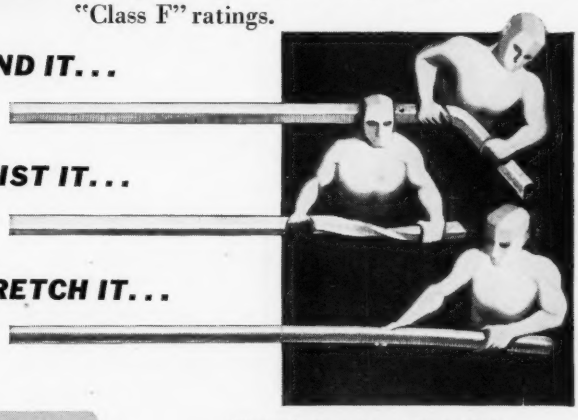
Daglas magnet wire consists of bare or enamelled copper wire, wrapped with a combination of Dacron and glass and heated to fuse the glass fibres in place. An overall coating of varnish is applied, providing a smooth finish and improved resistance to abrasion. Daglas can also be supplied without varnish if required.

Daglas is supplied in square and rectangular sizes from #14 to #1 AWG and in round sizes from #23 to #1 AWG, with "Class B" and "Class F" ratings.

Daglas has greater flexibility. In sharp bends where ordinary glass insulation cracks badly, Daglas leaves no wide open cracks—adheres perfectly.

Superior adhesion of Daglas insulation prevents unravelling and separation even when twisted. Greater resistance to damage from abrasion.

When conductors are elongated to breaking point Daglas still adheres tightly—no fraying at the ends and no unravelling as with ordinary glass insulation.



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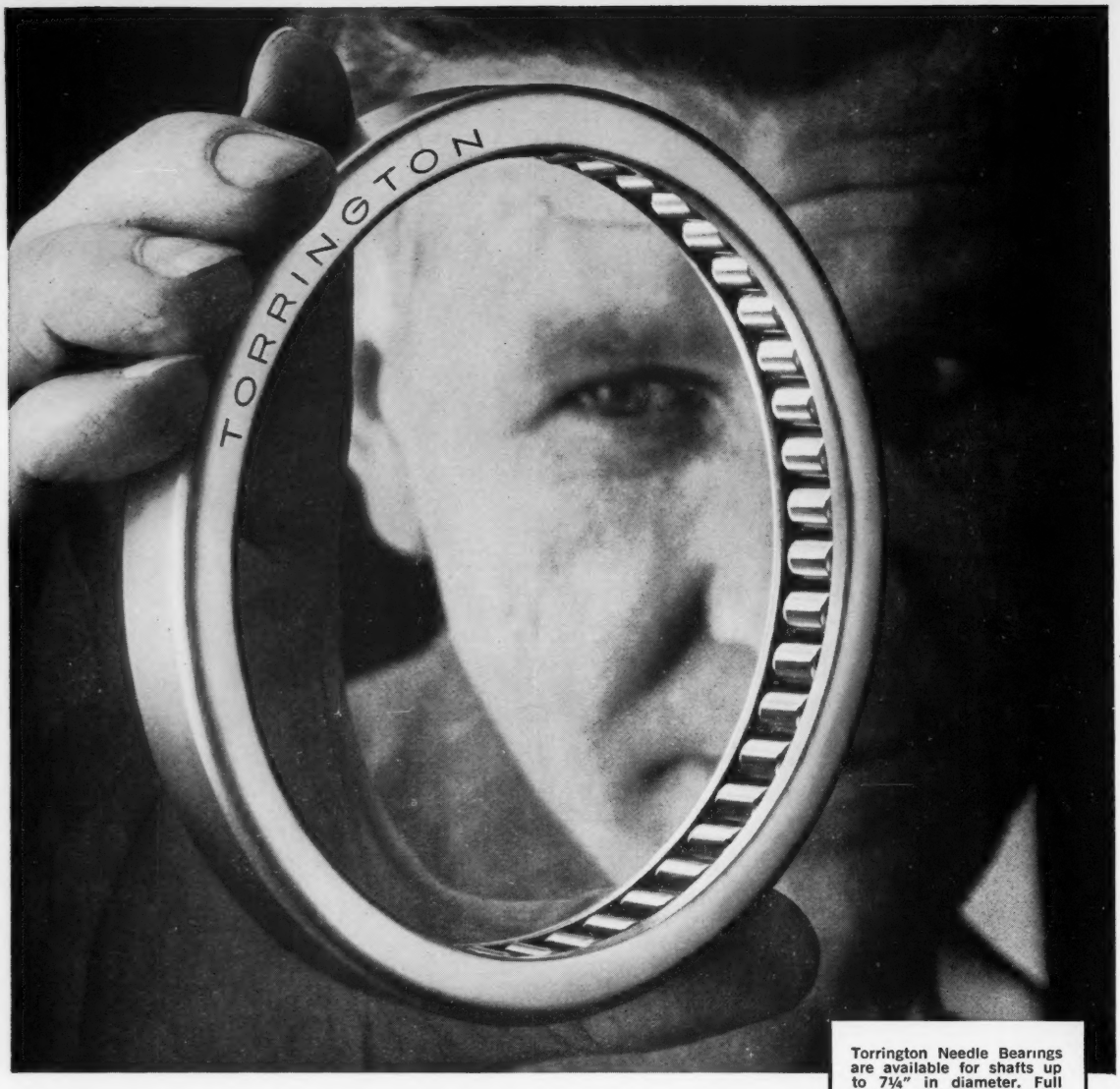

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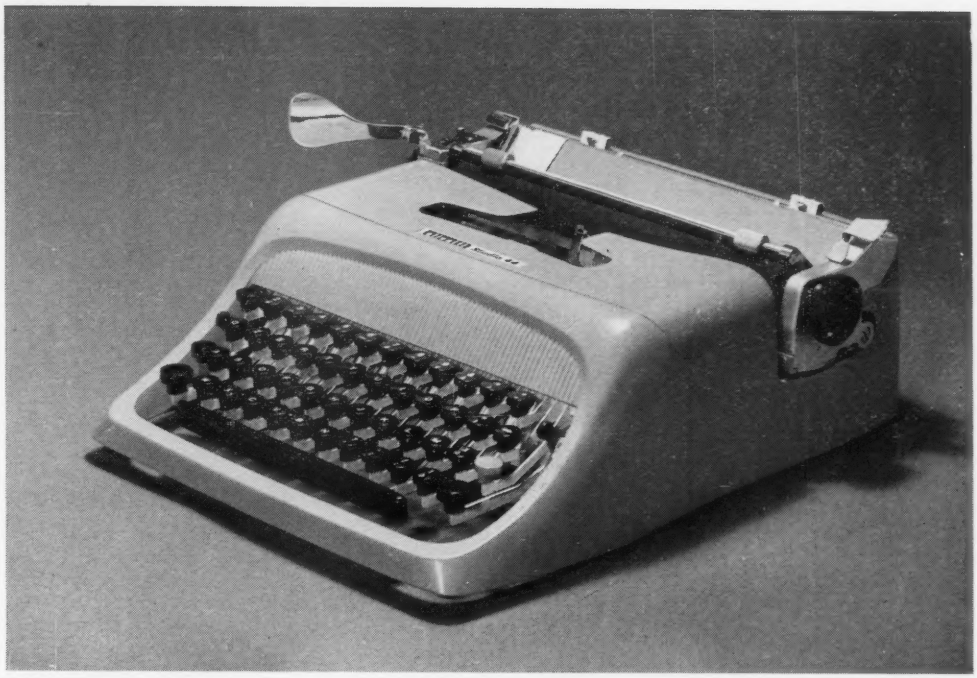


Typewriter gets curves by casting

John W. Dennis

The Studio 44 is an Italian design that merits special interest because it combines acceptable poundage (the weight is only 15 lb) with the desirable features of a standard office machine.

The smoothly-rounded casing contours contribute much to its appearance and Olivetti used castings to handle the compound curves. With an eye on weight, aluminum was chosen. This takes a baked enamel finish well and, at the same time, gives the casing the necessary rigidity and strength. Aluminum in fact, plays a big role in the construction: out of about 800 parts, over 100 are in this light alloy.

The casing is in two parts. The smaller (and upper) one, which covers the type bars, snaps a spring off a tongue cast into the main casing. In doing so, it exposes two of the four bolts holding the main casing to the frame. Moving the carriage from side to side reveals the other two.

Now that the covers are off, the complexity of a typewriter really becomes apparent. Much of the mechanism is on a par with that of a household alarm clock.

The ability of the working parts to hold their alignment is largely due to the extremely sturdy aluminum frame, one side member of which is shown in Fig 5.

This intricate design, which provides a multiplicity of mounts and bearings all in a single light-alloy casting, is a cornerstone in the construction of the typewriter.

Most of the cost of such machines is in the type bar segment (shown complete in Fig 4). It is to this that the 43 individually angled type bars are wired. The framework of this segment is a combination aluminum casting and steel stamping, specially designed so that the typewriter can be used on an incline, without the risk of unexpected switches from lower to upper case characters.

Stampings, of course, make up the majority of the movement parts in a typewriter and some of them are very small and complex. Where they

Two previous Design Engineering articles in this series, one on an electric floor polisher (Feb. '59), the other on a fishing reel (March '59), have taken readers on an undercover story of familiar items. This article dissects the Olivetti Studio 44 typewriter.

continued

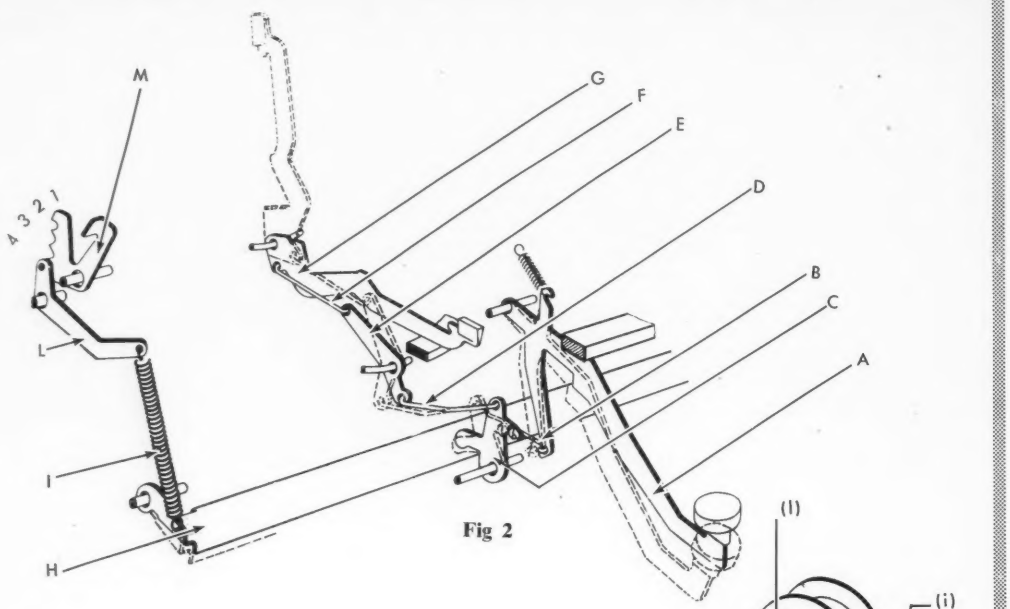


Fig 2

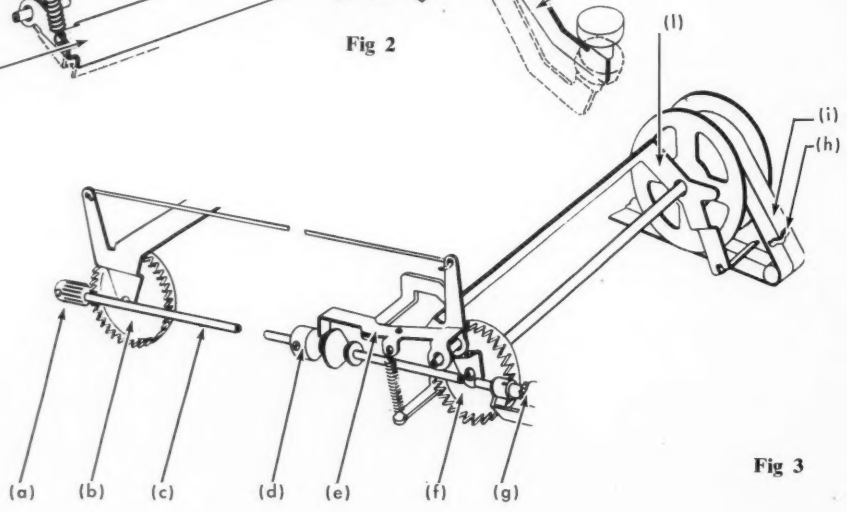


Fig 3

are long or have heavy work to do (as in shift key or space bar levers) they are either fluted or of considerably heavier section.

The typebar action (Fig 2) is based on the principle of progressive acceleration. The mechanism linking the key with the typebar is so designed that the typebar moves with progressive acceleration from its rest position towards the platen.

The advantages of this kind of action lie in the lightness of the stroke required on the keys, and the high speed with which the type strikes the platen.

Another feature that ties in with the typebar action is a control which makes the touch lighter or heavier. These two units work together as follows (the full lines show the parts at rest and the dotted lines their positions when moved):—

When a key is hit, the corresponding lever A, through link B, moves the first movement lever C towards the back. Lever C, by means of link D, causes the second movement lever E to turn towards the front. Lever E, by means of pull rod F, raises type bar G.

In its backward rotation, first movement lever C lowers lug H of the ribbon movement. The latter determines the lift and feed of the ribbon.

A certain force (which depends on the tension of the spring I) is required to lower lug H. Through lever M and corresponding arm L, four different tensions can be given to the spring. The force necessary to lower the keys can thus be varied, and the touch adjusted to suit the typist.

The chief engineering problem facing the designer of a typewriter watching its waistline is to confine complex movements to a limited space. The typebar

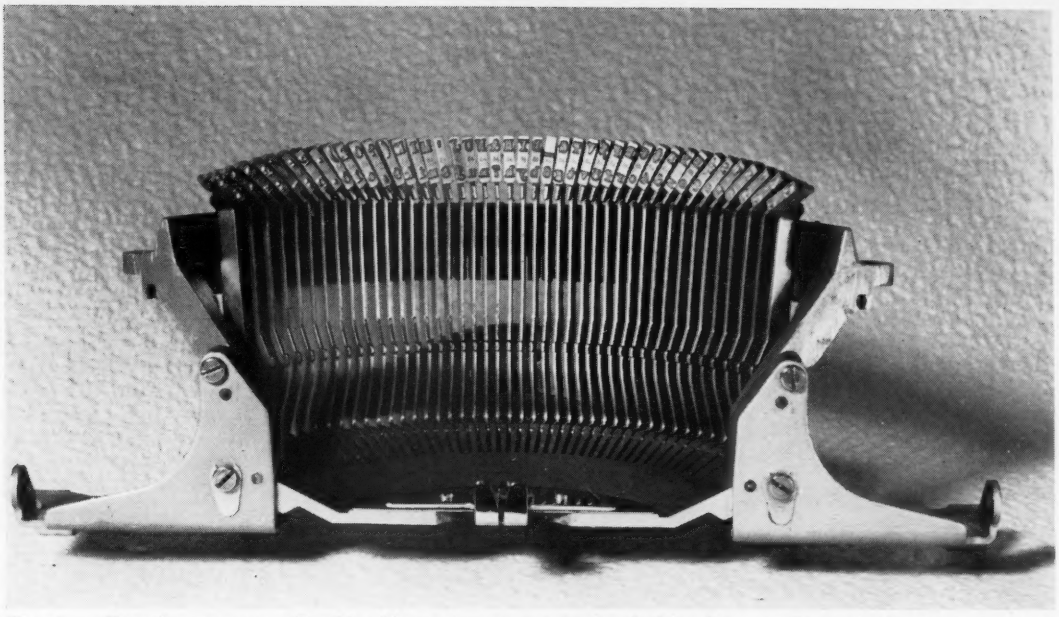


Fig. 4 — Type bar segment. Considerable portion of cost is absorbed by this part. Frame is aluminum and steel.

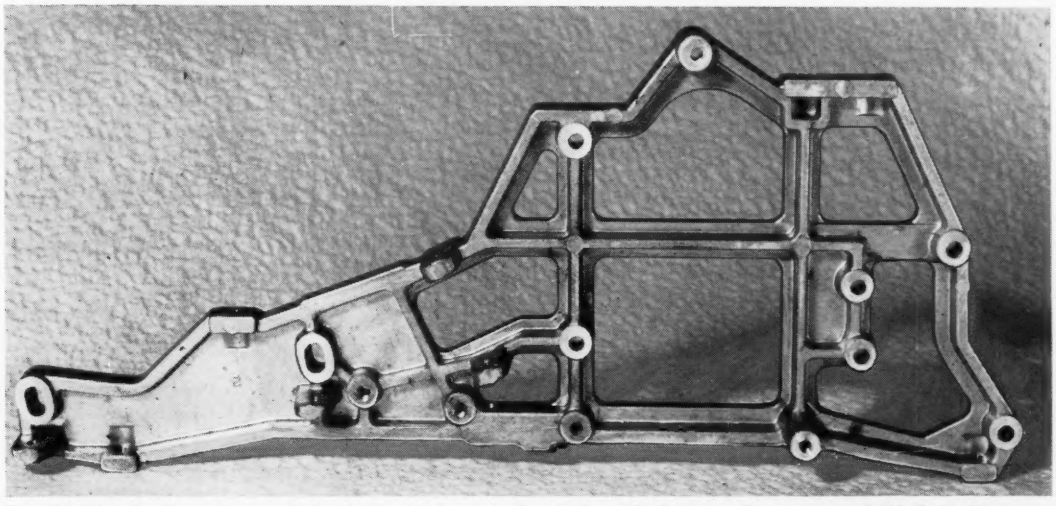


Fig. 5—The aluminum frame of the Studio 44 is extremely sturdy and allows working parts to hold their alignment.

action just described is (don't forget) just one of 43 movements laid, sardine fashion, under the casing.

To dismiss the intricacies of a typewriter as the typebar action, carriage, platen and little else is to pass over some of the most canny space/size/movement solutions under the shell. A multitude of arms, gears and springs feed and reverse the ribbon, release the carriage, back-space, set and clear the tabulator, grip and release the paper, hold margins, and so forth.

One more of these movements will be described here. This is the ribbon reverse, shown in Fig 3.

It is controlled by two hooks (h) which are attached to the ends of the ribbon itself. The ribbon is pulled by the toothed wheel (b) which makes the corresponding spool rotate and unwind the ribbon from the other, which turns freely in neutral.

Shaft (c) is held in position by cam (d) and the corresponding positioner (e). The ribbon carries the hook against lug (l) which drags positioner (e) along in its movement. The latter would, in the normal way, move shaft (c) to the right, but this movement is prevented by pinion (g) on the right-hand side of the machine. Consequently, positioner (e) rises along the inclined plane of cam (d), descending on the next one.

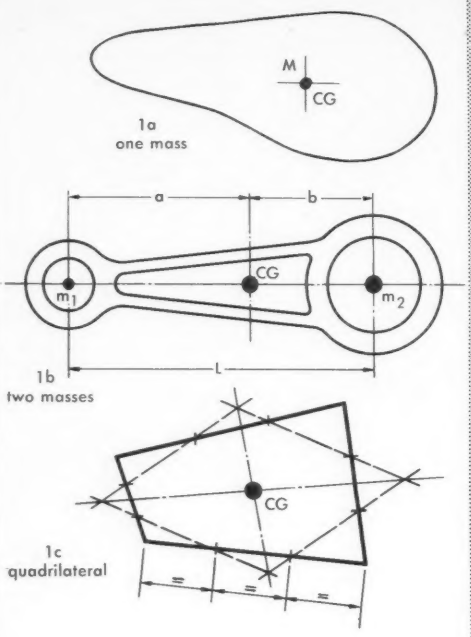
Shaft (c) is therefore pushed towards the left; pinion (a) disengages from wheel (b) while pinion (g) meshes with wheel (f). The latter causes the other spool to turn and to wind the ribbon back on itself.

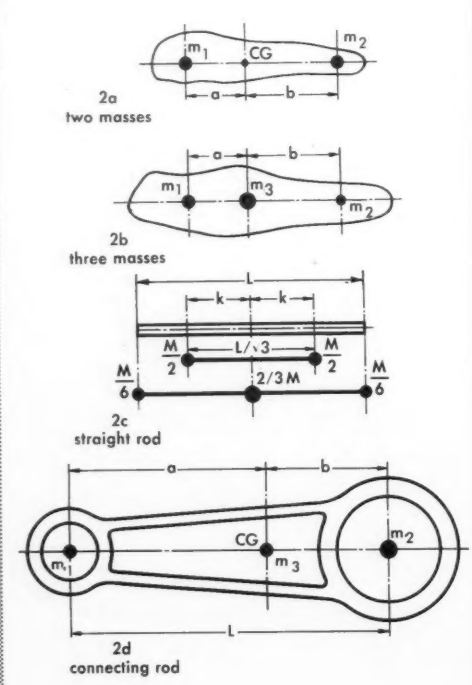
Anything but a homely piece of design engineering under the skin, the typewriter is one of the unsung masterpieces of compromise. To get so much into so little (and have it look good) has been no easy task. ★

It is well known that a distributed mass may be regarded as concentrated at its centre of mass (which to all practical purposes is at its centre of gravity). This only applies to static considerations, however, and ignores the effect of rotary inertia. If that is included, the total mass must be considered as concentrated at two or more distributed points, to give the same effect. A thorough understanding of these substitute masses can shorten design calculations in static and dynamic balance, the design of control surfaces and the design of substitute masses for test rigs and the like.

The consolidation of distributed masses

W. H. Sheppard





I Static equivalence

In this case the centre of gravity (*CG*) of the substitue masses must be coincident with that of the original.

(a) *One mass.* This is the simplest case, Fig. 1 (a). The mass M is at the *CG* in accordance with common practice. This is simple if the position is known, but otherwise must be determined by recognized methods.

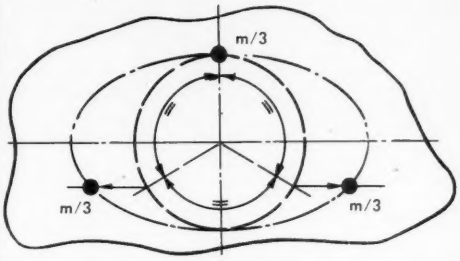
(b) *Two masses.* Equal masses $M/2$ may be disposed at any equal distance from the *CG*. Unequal masses m_1 and m_2, Fig. 1 (b), may be disposed at distances "a" and "b" such that $m_1a = m_2b$ thence $m_1 = \frac{bM}{L}$ and $m_2 = \frac{aM}{L}$, a typical example being the connecting-rod shown.

(c) *Three or more masses.* Equal masses may be disposed at equal distances apart round the circumference of a circle with centre at the *CG*. Equal or unequal masses may be disposed in any manner that gives the same *CG*, i.e.

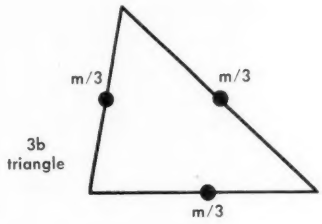
$$\bar{x} = \frac{\Sigma mx}{M} \quad \text{and} \quad \bar{y} = \frac{\Sigma my}{M}$$

Equal masses may also be disposed at the corners or at the centres of edges (or faces) of the regular solids viz. cube, tetrahedron, octahedron and so on.

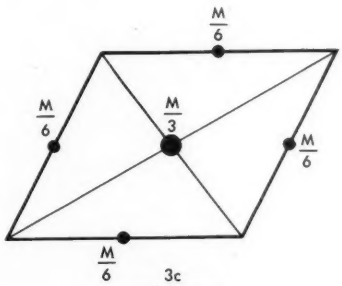
Quadrilateral. Fig. 1 (c). In this special case, the *CG* may most easily be determined by trisecting the edges and drawing a parallelogram through the points obtained. The *CG* is at the intersection.



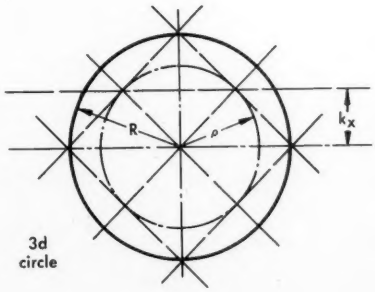
3a
plane figure



3b
triangle



3c
parallelogram



3d
circle

Alternatively, the quadrilateral may be regarded as having equal masses $M/4$ at each corner or at the centre of each side and an equal negative particle $M/4$ at the intersection of the diagonals.

II Dynamic equivalence

In general, dynamic equivalence, that is, the same moment of inertia about any point is required (together with static equivalence) to give the same total mass and the same *CG*. Let $m_1\ m_2\ m_3$ be the individual masses and $x_1, x_2, x_3 \ldots . y_1, y_2, y_3, \ldots .$ be their respective distances from the axes.

For the same total mass, $\sum m = 0$

For the same *CG*, $\sum mx = 0$

For the same moment of inertia,

$$\sum mk^2{}_x = Mk^2 \quad \text{and} \quad \sum mk^2{}_y = Mk^2$$

IN-LINE MASSES

(a) *Two masses.* These must be disposed on a straight line through the *CG*. By substituting in the formulae, it can be shown that $k^2 = ab$ [Fig. 2 (a)]. The simplest case is to take $m_1 = m_2 = M/2$ whence $a = b = k$.

(b) *Three masses.* Referring to Fig. 2 (b) it will be realized that the distances may be chosen to suit the masses or vice versa. Again by substitution in the formulae it may be shown that:—

$$m_1 = \frac{Mk^2}{a(a+b)} \quad \text{and} \quad m_2 = \frac{Mk^2}{b(a+b)}$$

or alternatively

$$a^2 = \frac{m_2 Mk^2}{m_1(m_1+m_2)} \quad \text{and} \quad b^2 = \frac{m_1 Mk^2}{m_2(m_1+m_2)}$$

If $a = b$, $m_1 = m_2$ and $2a^2m = Mk^2$

In all cases, $Mk^2 = I$, the moment of inertia.

Straight rod

In this case, shown in Fig. 2 (c), the two concentrated masses $M/2$ will be disposed at a distance $L/2\sqrt{3}$ from the centre, or $L/\sqrt{3}$ apart. Alternatively, a mass $M/6$ may be considered at each end and $2M/3$ at the centre.

Connecting rod

This is a very important case, for it is often stated that a connecting rod cannot be represented dynamically by concentrated masses, unless extended beyond its ends. This is true of two masses, but three masses give a relatively simple result, as in Fig. 2 (d). Let L = length of connecting rod between centres and "a" and "b" the distances to the *CG*. Then the connecting rod may be considered in full dynamic equivalence (including product of inertia, as will be explained later) by I/aL at the small end, I/bL at the big end and the remainder at the *CG*, I being the moment of inertia about an axis through the *CG*.

Note. It should be clearly understood that in-line substitutions only apply to slender items or where (as in the case of the connecting rod) the effect of rotation about a laterial axis is considered. With further regard to the connecting rod, it will be appreciated that the mass could be regarded as concentrated at the centre of oscillation, but this

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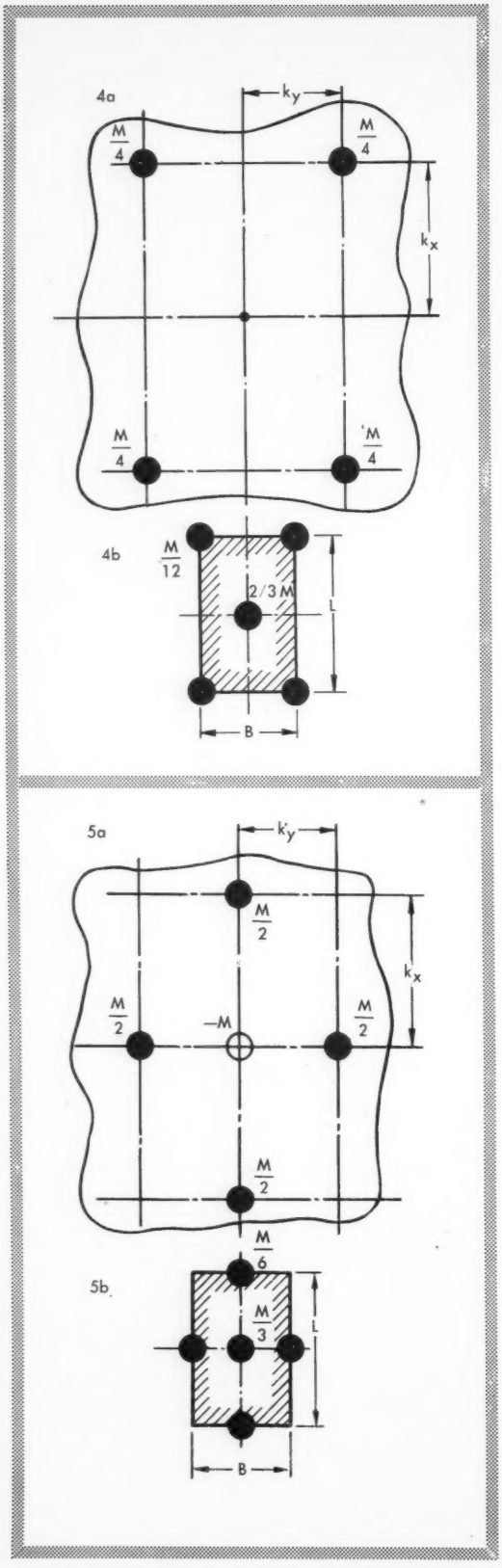


would apply only to oscillation about the small end, whereas the three point substitution gives complete equivalence.

PLANE DISTRIBUTED MASS

It may be shown mathematically that a uniform plate may be regarded as concentrated round the circumference of a circle of radius equal to the polar radius of gyration (ρ) which for a circle is equal to $R/\sqrt{2}$. (The linear radius of gyration for a circle $= \rho/\sqrt{2} = \frac{R}{2}$).

Fig. 3 (d) shows a neat construction for the radius of gyration of a circle. It may further be shown that this circle can be regarded as any number of equal masses disposed equally around this circle. This also applies to any regular figure which has more than two lines of symmetry. In the case of a triangle, the masses are at the centres of the sides, as in Fig. 3 (b). In general for irregular figures, Fig. 3 (a), the masses may be considered as on an ellipse expanded from a circle in the ratio:

$$\frac{a}{b} = (k_x/k_y)^2$$

a and b being the semi-axes. If the masses are not considered at the polar radius of gyration, it will be necessary to introduce a positive or negative mass at the *CG* to give the correct total mass, but this is not necessary if the total weight is not be considered. Three masses are the least number required in a plane configuration but 4 give greater symmetry and ease of application. Polygons may also be made of triangles, as in parallelogram Fig. 3 (c).

Fig. 4 shows rectangular arrangements. The simplest case is with the masses equally distributed at the corners of the rectangle formed by the radii of gyration (Fig. 4). This has the advantage that no central mass is required. In the case of a rectangular plate k_x^2 is equal to $L^2/12$ and similarly for k_y. However, if in this case the masses are disposed at the corners, as in Fig. 4 (b), a central mass must be introduced. Conversely, if it is desired to make a rectangular plate to equivalent k values, $L = 2\sqrt{3}\,k_x$, and similarly for k_y with the same density and thickness.

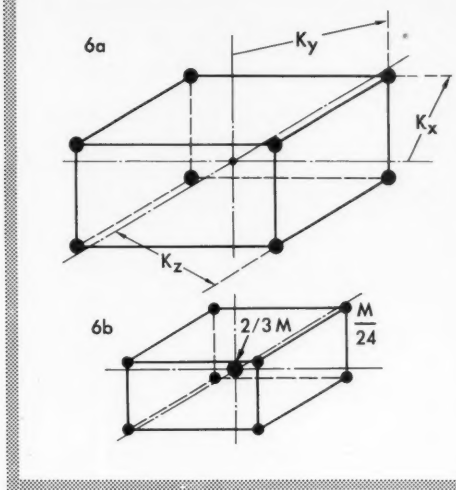
Fig. 5 shows "spider" arrangements. These have the advantage that the masses are on the principal axes, but a compensating mass is normally required at the centre to give the correct total mass. It may be shown mathematically that in any case

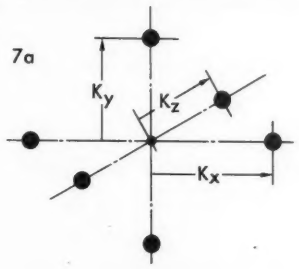
$$\frac{a}{b} = (k_x/k_y)^2$$

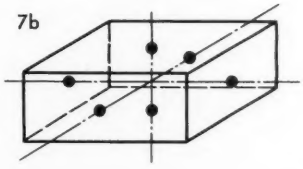
and this applies also to rectangular arrangements. With the arrangement shown, the substitute masses are as indicated, but if $a = \sqrt{2}\,k_x$ and $b = \sqrt{2}\,k_y$ there is no central mass. If the masses are considered at the corners of a rectangular plate, as in Fig. 5 (b), the values are as shown. Unequal masses may be used giving a variety of arrangements.

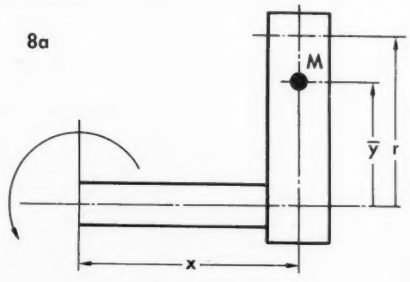
In particular

$$m_1 = \frac{M}{2}\left(\frac{k_x}{\rho}\right)^2 \quad \text{and} \quad m_2 = \frac{M}{2}\left(\frac{k_y}{\rho}\right)^2$$









In this case, there is no central mass and $a = b = \sqrt{a^2 + b^2}$, the polar radius of gyration ρ. With regard to the rectangular plate $a = \sqrt{2}\,k_x$ and similarly for b. Masses at this distance would have no central compensating mass.

SOLID DISTRIBUTED MASSES

This section will be considered in a similar manner to the previous but, for convenience in exposition, simple arrangements will be considered first. Fig. 6 shows the rectangular arrangement. Equal masses are arranged at a distance K from each axis and it will be appreciated that here again there is no central mass. The dispositions are more difficult to calculate however. If a, b and c are the half sides of the rectangular prism formed,

$$a^2 = \frac{1}{2}\,[K_y^2 + K_z^2 - K_x^2]$$

and similarly for b and c.

If the masses are not at the radius of gyration

$$m = \frac{M}{8}\left[\frac{K_x}{\alpha}, \frac{K_y}{\beta}, \frac{K_z}{\gamma}\right]^2$$

where α, β and γ are the respective distances.

In the case of rectangular prism of dimensions A, B and C.

$$K_x^2 = \frac{1}{12}\,(B^2 + C^2) \text{ and } a^2 = \frac{1}{24}\,(2A^2 + B^2 + C^2)$$

and so on.

Conversely, if it is desired to make a rectangular prism of equal K values

$$A^2 = 6\,(K_y^2 + K_z^2 - K_x^2)$$

and so on.

Fig. 7 shows the spider arrangement. This has the advantage that K values are considered in the direction of the principal axes.

If the masses are equal

$$a^2 = \frac{M}{4m}\,(K_y^2 + K_z^2 - K_x^2)$$

III Centrifugal force

Referring to Fig. 8 (a), for centrifugal force purposes the crank may be considered concentrated at the CG and its effect at the crankpin is $\frac{W}{r}\bar{y}$.

Considering the product of inertia of a distributed mass

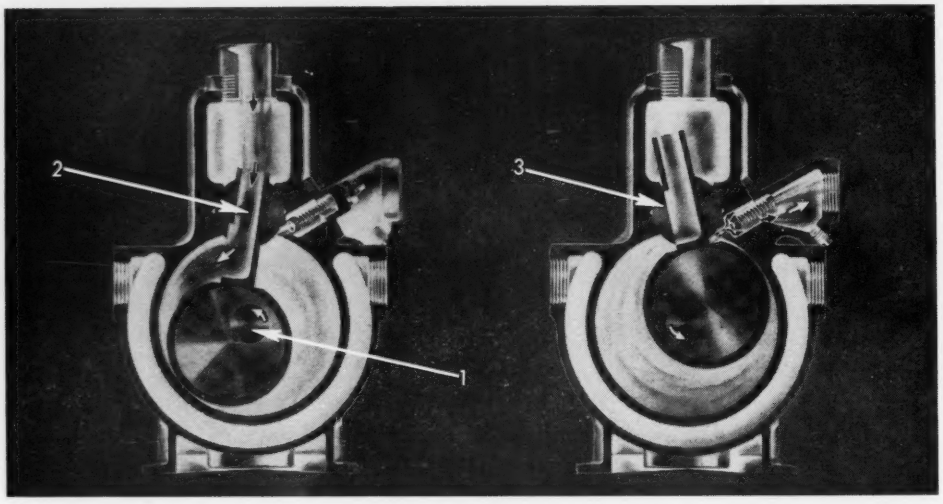
$$P = (I_z - I_y) \sin\theta . \cos\theta$$

from which it follows that any configuration with the same moment of inertia (or the same difference in moments of inertia) has the same product of inertia in any direction. In particular, the equivalent systems mentioned previously will have equivalent products.

If only product of inertia is being considered, a simple 2-mass system may be considered as in Fig. 8 (b).

Then $m = \frac{M}{2}$ and $a = \sqrt{K^2_y - K^2_x}$

This is of importance in the balancing of engines, correcting "wobble" in rotors and similar problems. ★



The mechanism of the Kinney pump is extremely simple and no special tools are required for its maintenance. There are three basic moving parts: 1. The shaft on which is keyed the eccentric cam. 2. The piston with its integral hollow extension which contains the inlet port. 3. The box-type slide pin.

The rotating motion of the cam causes the piston extension to move freely up and down in the slide pin, thus opening and closing the inlet port. The simplicity of the Kinney pump—without sliding vanes or piston rings—contributes greatly to its long life and trouble-free performance.

Vacuum pumps: work-horses of industry

High vacuum is considered as that point where pressures go below 1 mm mercury, which is roughly a thousandth of atmospheric pressure.

To produce these low pressures and harness them to industry, three main types of vacuum pump are in use today. These are (1) the rotary oil-sealed pump (2) the positive displacement mechanical pump and (3) the vapor pump. Holding great promise is a new type of pump, (4) the electronic "Evapor-Ion" pump, which operates by metallic evaporation and ionization.

Although for some operations the various types are interchangeable, the special characteristics of each type make it possible to pick up a pump with the maximum efficiency for a particular use.

Every day in thousands of industrial plants, vacuum pumps are hard at work.

They make it possible to vacuum metallize (at low cost) nameplates, costume jewelry and toys. They have improved the performance of electrical capacitors, rectifiers, resistors, and precision optics (such as lenses, mirrors and sunglasses).

High vacuum techniques have also solved many of the long-standing problems of metallurgy. As a result, we now have the high-purity metals and alloys essential for jet engines and other modern industrial uses.

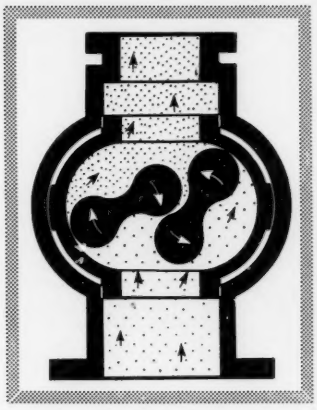
(1) Rotary oil-sealed pumps. The only type of mechanical pump that can produce a pressure of 0.1 mm Hg or less (and still exhaust against atmospheric pressure) is the rotary oil-sealed pump. Basically, pumps of this type consist of a cylindrical rotor, mounted on a shaft within a cylindrical housing of larger diameter than the rotor.

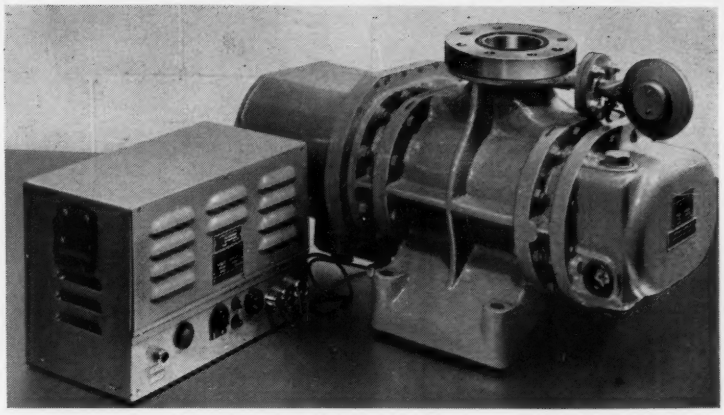
The Welch, the Cenco, and the Kinney (shown in fig A1) are typical of the rotary oil-sealed mechanical pumps in wide use today.

How They Work

The rotor maintains contact with the housing, and together with one or more sliding vanes, divides the volume between the rotor and housing into two or more chambers. As the rotor turns, one chamber (connected to the intake) expands and another (connected to the exhaust) contracts. An oil film seals the pump at the contact points and a valve seals the contracting chamber against the inward flow of atmospheric gas. This positive-displacement type of pump can be used alone (or as a forepump) to lower the pressure into the operating range of a vapor pump.

As the operating pressure is reduced, the efficiency of this type decreases: at pressures of a few hundred microns of mercury, its efficiency generally becomes less than that of vapor pumps. Thus, for many repetitive processes (where time is an important factor) vapor pumps are often used, even though the processing pressure is at the lower end of the mechanical-pump range.

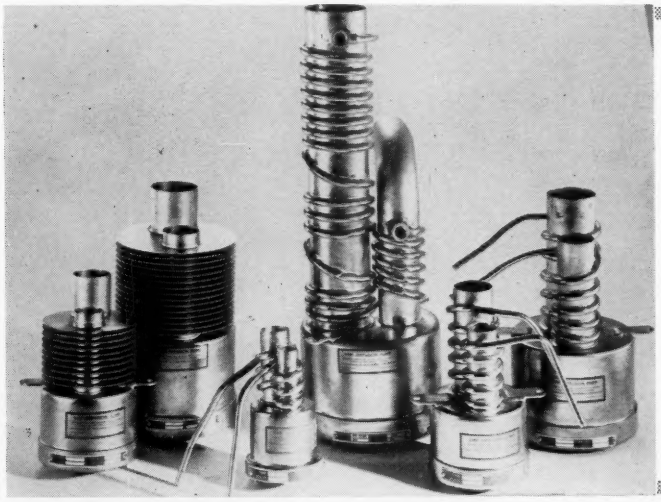


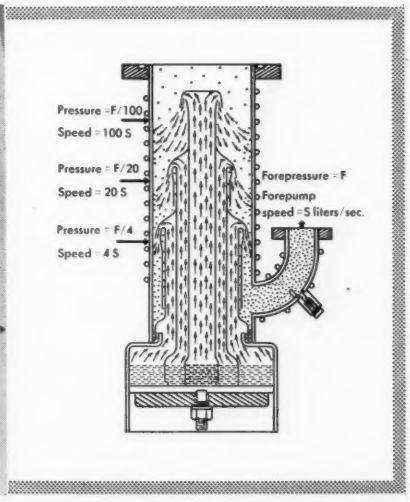


(2) Positive-displacement pumps. Typical of the positive-displacement mechanical pump is the Heraeus Roots-type vacuum pump (shown above). It is designed for economical vacuum processing operations which require: (a) pressures in the 10 to 10^{-4} mm Hg range; (b) a vacuum uncontaminated by back-streaming oil vapors; (c) high pumping speed; and (d) a pump unaffected by dust. The maximum speed and throughput of these pumps is in the pressure area between oil-sealed rotary-piston pumps and vapor pumps.

The basic operating mechanism of the Heraeus Roots pump is a pair of figure-eight-shaped rotors which counter-rotate in the pump chamber (left, above). These rotors (carefully machined to close tolerances) do not touch each other or the wall of the pump chamber. Accurate shaping reduces the gap between each rotor and the chamber wall, so that the flow resistance rises as the pressure decreases.

Heraeus Roots pumps do not require bypass lines, because a pressure differential of a few millimetres of mercury causes the pump rotors to turn. Preliminary evacuations are performed directly through the Roots pump. No valves are needed, except when essential to a specific processing operation.





(3) Vapor pumps. Today's standard for creating the highest vacuum is the vapor pump, which falls into three classifications: diffusion pumps, ejector pumps or diffusion-ejector pumps.

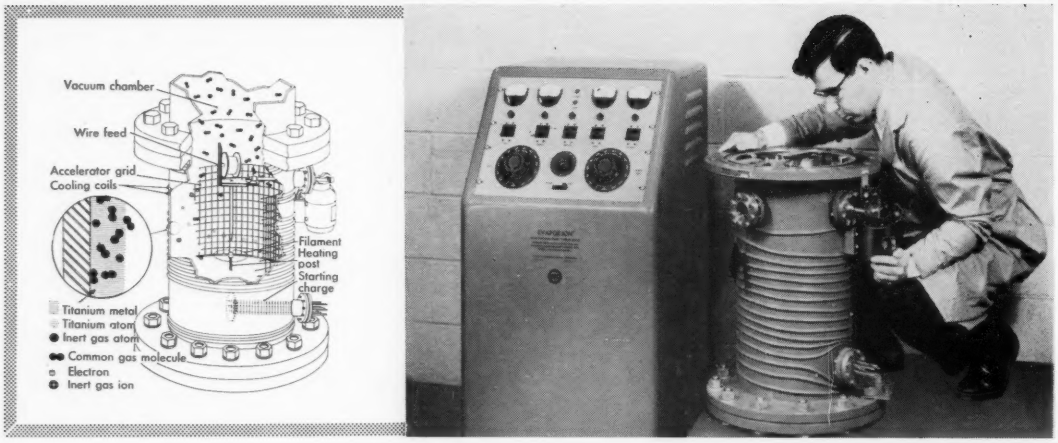
The diffusion pump produces lower ultimate pressures than any other type of vapor pump. It consists (see above) of a water-cooled jacket containing a matching boiler-and-jet combination and some specially compounded pump fluid. Since the fluid is the only moving part of a diffusion pump, requirements for it are very rigid: it must be chemically and thermally stable and possess exactly the right vapor-pressure characteristics for its application.

As the pump fluid is vaporized, its molecules rise up through the jet stack columns and are emitted through annular orifices which force them downward and outward at supersonic speeds. Gas molecules entering the jet region are bombarded by the heavier pump-fluid molecules and propelled downward. The gas is thus compressed into the lower part of the pump, where it is removed by a mechanical pump. The pump-fluid vapor condenses on the cooled wall and returns as a liquid to the boiler. Here it repeats the cycle as long as the heating element is energized.

This basic principle is employed in full diffusion pumps. They range from a 2 in. diameter model (suitable for exhausting tv tubes) to a pump of nearly 3 ft diameter (used on giant synchro-cyclotrons, linear accelerators and metallurgical furnaces).

For use at pressures near the low end of the operating range of the oil-sealed, rotary-piston mechanical pumps, metal diffusion-ejector pumps are available.

continued



(4) The Evapor-Ion pump. Latest development in high-vacuum pumps is the so-called Evapor-Ion or electronic pump. This pump removes many times its own volume of air from a system, yet it is operated without an outlet. As shown above, titanium wire is fed onto a post heated by electron bombardment from the filament. The titanium evaporates and, on striking the cooled pump wall, condenses as a thin layer.

Gas molecules wander into the pump from the vacuum chamber, collide with the surface of the wall, and chemically combine with the titanium. Chemically active gases (which make up over 99% of the air) are held as compounds by the titanium. As each layer of titanium becomes chemically saturated, a fresh layer is deposited. The inert gas molecules are ionized by electrons emitted by the filament. The electrical field of the accelerator grid violently repulses these ions and drives them into the titanium layer, where they are buried by subsequent titanium evaporation. This constant removal of gas molecules by evaporation and ionization produces a pressure in the range of from 10^{-4} to 10^{-9} mm Hg, uncontaminated by the fluids used in conventional pumps. Nitrogen is pumped at speeds as high as 2,000 liters per second.

The Evapor-Ion is ideal for noncyclic systems such as betatrons, synchrotrons and other particle accelerators, and has potential applications in the fields of metallurgy, electronics and metallizing.

APPLICATIONS

In **vacuum metallizing,** both mechanical and oil diffusion pumps are used in high-vacuum metallizing work. This is a fast, economical method of giving color and high-quality finishes to plastics, metals, glass and other materials. (It was described in Design Engineering, Oct. 1955.)

Vacuum metallizing is also employed in a variety of nondecorative, precision applications such as printed circuits, condensers, transistors, selenium rectifiers, quartz crystals for radio transmitters and lenses. Coating of lenses with magnesium fluoride is especially interesting because the thickness of the metallic salt must be controlled to less than one-quarter wave length of the mercury-green band of light. This coating reduces reflected rays and actually increases the amount of light transmitted.

A number of vacuum metallizing systems are available. Consolidated Electrodynamics, for example, makes coating units with chambers ranging from 12 in. dia x 18 in. to 72 in. dia x 60 in.

The commercial vacuum metallizing process is made possible by high-efficiency vacuum pumps. For example, the 30 in. (chamber size 30 in. dia x 45 in.) vacuum coater, right, uses three pumps: a 14-in. high-speed oil diffusion pump, a 100 cfm mechanical roughing and backing pump and a 3.5 cfm mechanical holding pump. Working together, these pumps reduce the pressure in the empty chamber to 0.5 microns in less than five minutes. Line valves enable the 100 cfm pump to be used for "roughing" the chamber, while the 3.5 cfm mechanical holding pump maintains diffusion pump forepressure. The diffusion pump is isolated from the chamber during "loading" and "roughing" by a pneumatically operated valve, which when open functions as a baffle to condense out residual organic vapors.

In **dehydration,** high-vacuum pumps are being used to get many industrial products really dry. For example, Timken Roller Bearing Co. has solved the problem of getting the last bit of moisture from its large bearings so that the finished surfaces do not corrode.

The bearing is first washed in a hot water-soluble oil emulsion. It is then placed in a high vacuum chamber where the pressure is quickly reduced by an efficient

oil ejector pump to nine microns Hg (about one millionth atmospheric pressure) and held for 20 minutes. This removes every trace of water. When covered with petrolatum, the bearing remains in perfect condition until ready for use.

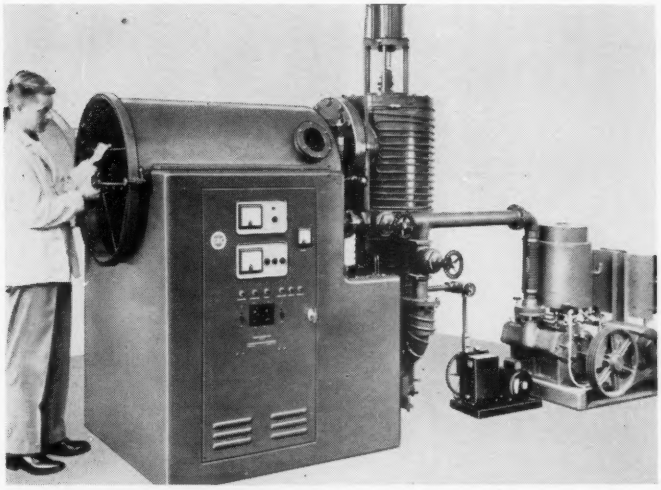
In **vacuum metallurgy,** modern high-vacuum furnaces have solved many of the age-old problems that held back progress in metallurgy.

As a result, the volume of high-purity metals and high-temperature alloys has increased tremendously.

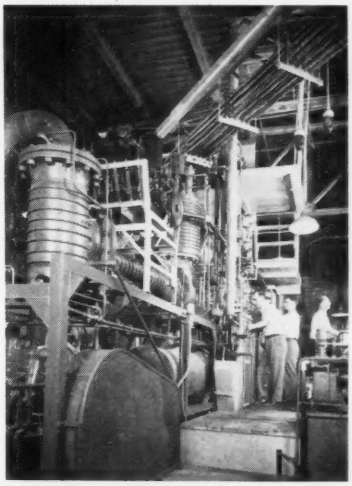
Pressures as low as one 50-millionth of atmosphere are now being used in the melting of metals, to provide high purity materials having superior creep and tensile strength, ductility, forgeability and fatigue-resistant qualities. Design engineers are making use of these exceptional metals to produce jet engines, aircraft frames, bearings, electronic components, fine tools and other products demanding long life, dependability and improved performance.

These furnaces are equipped with special high-vacuum pumps. For example, in the Consolidated 5-to-50-lb melting and casting furnace, a two-stage diffusion-ejector pump brings the system swiftly to the low micron Hg pressure range, with plenty of reserve capacity for pressure surges from alloy additions, deoxidation and pouring.

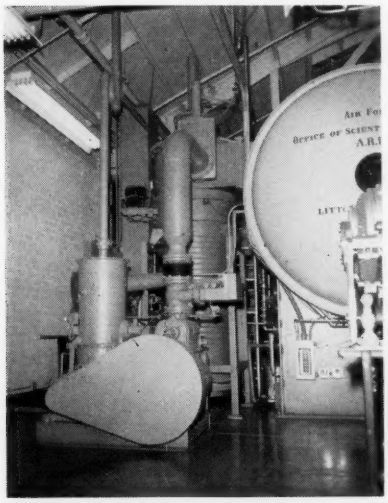
At Climax Molybdenum Company, a large oil ejector pump (below) solves the problem of producing pure molybdenum without oxygen. ★



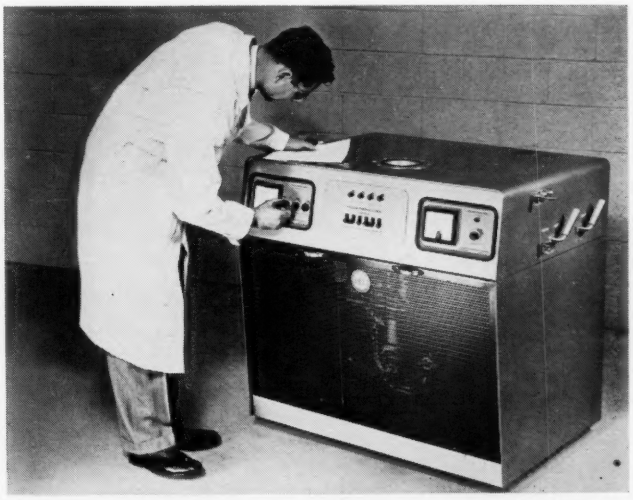
Consolidated Electrodynamics type LC1-30 vacuum coater for economical plating of materials with metals. Pumps are 14-in. oil diffusion, 100-cfm roughing and 3.5-cfm holding.



Another type of ejector pump manufactured by the Consolidated Electrodynamics Corporation. Pump (above right) is part of vacuum furnace at Climax Molybdenum Company.



In foreground is a Kinney KD-310 mechanical pump while behind it is a MCF-15000 32-in. diffusion pump. They form part of equipment at Litton Space Research Laboratory.



Packaged, vacuum pumping system designed for laboratory and pilot plant use. Basic unit includes diffusion, mechanical pumps — and three valves which allow rapid cycling.

Updating your automatic control system

This article is based on the conviction that even "perfect" systems can be improved. But it also shows you how to use inexpensive devices.

Your automatic control system may be doing a bang-up job, but very probably it can do more. It won't require a major operation on your present system (and there'll be no need to take equipment out of service) to add contacts, relays or switches. You'll need additional items, but the cost will be a petty-cash expenditure. For instance, if your present electric controller could perform an additional function with an additional pair of contacts, it can be done without modifying the controller. Or, if your system is 100% pneumatically operated, and you want an electric signal, you can get that signal by installing a simple pressure switch in the existing pneumatic circuit.

These inexpensive devices (when used as auxiliary components for both simple and complex control systems) can be adapted, regardless of the controlled variable. Furthermore, they can be installed to function properly in any control system, regardless of the make of the primary controlling instruments.

Although there's nothing new in the examples that follow (there are literally thousands of similar installations working daily) they may suggest ways of making your present control system work harder for you.

A. O. Pearson

Suppose you have a manual reset, proportional pneumatic controller operating a diaphragm control valve. You want to add a signal light, an audible alarm, or operate a solenoid valve. Installation of a simple pneumatic-electric relay in the output air line from the controller will solve the problem.

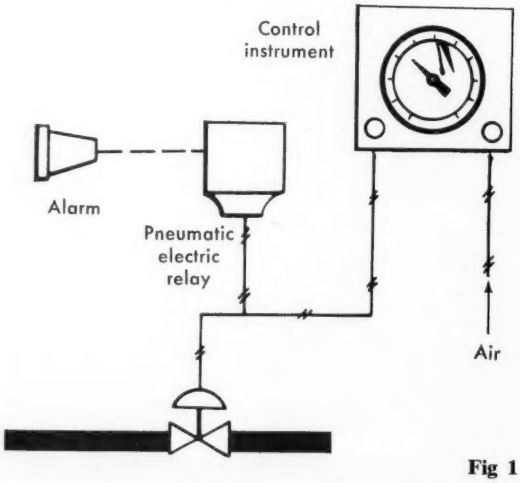


Fig 1

Let us assume that the air in the line between the controller and the diaphragm control valve can vary between 3 and 15 psi. Pressure at the control point is 9 psi. Suppose that 5 psi represents the low permissible limit and that 13 psi represents the high permissible limit. By adjusting the pneumatic-electric relay (Fig. 1) to 5 psi (for low limit) or 13 psi (for high limit), and

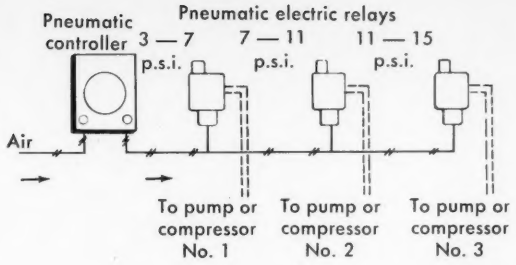

Pneumatic controller
Pneumatic electric relays
3 — 7 p.s.i.
7 — 11 p.s.i.
11 — 15 p.s.i.
Air
To pump or compressor No. 1
To pump or compressor No. 2
To pump or compressor No. 3

Fig 2

connecting the spst mercury switch to the alarm or signal light, you've solved the problem. Install two relays if you need both low and high signals.

If the operation of pumps, compressors, motorized valves or other electrically-energized equipment ties in with the job that a pneumatic controller is currently doing, you can adapt it to control the electrical machinery also by installing pneumatic-electric relays.

For example, a pneumatic controller can be used (as if Fig. 2) to control the operation of 3 pumps or compressors in sequence. The three pneumatic-electric relays (each electrically-connected to its own pump or compressor) are adjusted to "make" and "break" the circuit to the starters at different pressure signals in the controller's output air line. Thus, motor starter No 1 is energized when the pressure is 3 psi. Starter No 2 is energized when the pressure signal reaches 7 psi and No 3 begins to operate when the signal reaches 11 psi. The equipment is de-energized in the reverse sequence when the pressure signal decreases.

Pneumatic-electric relays will operate solenoid valves in sequence, as well as motor starters (or other electrically-energized final control elements). Relays with spdt switching action can be used in the same way to operate a two-position motorized valve.

Any one of several reasons may make it desirable to add a pneumatically-operated device to an electric control system, or to convert a portion of the electrically-operated system to pneumatic operation. For example, an electric controller is at present operating a fan and a remote damper motor. Because of process changes, the atmosphere around the damper motor becomes an explosion hazard.

There's an inexpensive solution. Replace the electric damper motor with a pneumatic damper operator. (Fig 3). Then install an electric-pneumatic relay. With this arrangement, the fan motor will still be operated from the electric controller. Note that the electric circuit is also connected to the electric-pneumatic relay. When the controller completes the circuit to the fan, it also completes the circuit to the relay. The relay then passes air through port 1 to 3 and in turn to the pneumatic damper operator to open the damper. When the fan is de-energized, so is the relay. Port 1 is then closed. Entrapped air in the damper operator bleeds off to the atmosphere through port 3 to 2, and the damper closes.

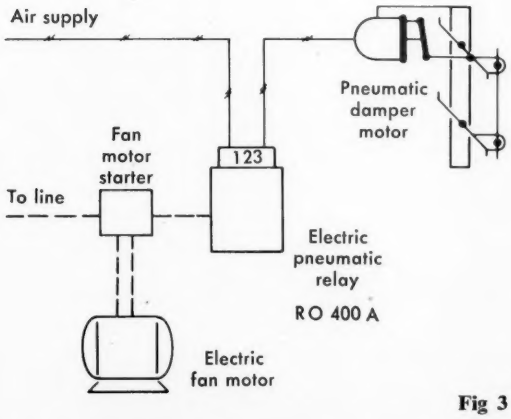


Fig 3

Change "Throttling" to "on-off"

Changes in processing may make it desirable to obtain snap-acting, on-off valve operation from a manual reset throttling type of pneumatic controller. Or it may become necessary to install a second valve in the pneumatic transmission line to operate on a strictly "fully opened-fully closed" basis, while the original valve retains its throttling control characteristics.

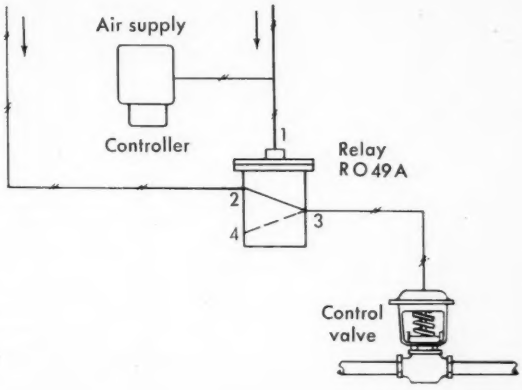


Fig 4

Snap-acting valve operation is obtained by installing a snap-acting relay in the system (Fig 4). With the addition of this relay in the output air signal line from the throttling, pneumatic controller, the valve motor receives either 0 psi or full air supply pressure (15 psi), nothing in between. The relay can be adjusted to snap and open the passage between ports 2 and 3 to the full 15 psi air supply when the output signal from the controller reaches any predetermined valve at port 1.

For any signal pressure at port 1 less than the adjusted set point value, port 2 is closed, and the passage between ports 3 and 4 is open, bleeding off air from the valve motor to the atmosphere.

Fig 4 shows only the installation required to operate a single valve on an on-off basis. For throttling operation of a second valve, merely tap the output air line from the controller to the relay.

There are many reasons why it may be necessary to start or stop pneumatic control operation by an electric signal. The signal can come from a separate electric control circuit, a timer, a manually operated switch or a motor.

For example, you can add an automatic electric timer to a pneumatically controlled batch process. Or,

continued

it is possible to influence and govern the normal control function of a pneumatic controller from a separate electric controller that may be controlling an entirely different variable (or the same one).

Suppose that you wish to add an automatic timer to start and stop a batch cooking operation. If the fuel valve is a diaphragm control valve (operated by the

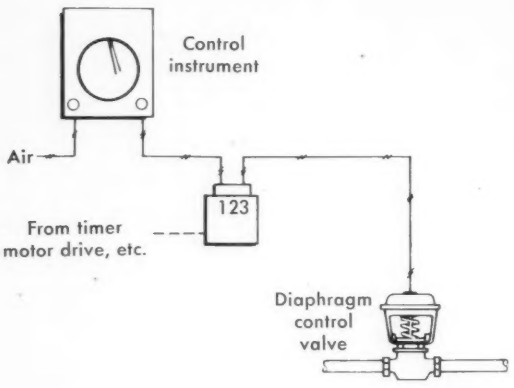


Fig 5

output air signal from a pneumatic controller) there's no need to disturb either the valve or the controller. If the cooking time for each batch is to be controlled by an electric timer, an electric-pneumatic relay (Fig 5) will open and shut the fuel valve when the time starts and stops.

When the timer starts, the circuit between the timer and the electric-pneumatic relay is closed. When the relay is energized, the output air from the control instrument passes through ports 1 and 3 to the air-to-open valve, and fuel is fed to the burners. When the timer stops at the end of the cooking period, the circuit to the relay is broken. When the relay is de-energized, instrument air is blocked at port 1 and entrapped air in the valve motor bleeds to atmosphere through the passage between ports 3 and 2.

The action of the relay can be reversed by connecting the air line from the instrument at port 2. With such an installation, the energized relay will block instrument air from going to the valve. A de-energized relay will pass instrument air to the valve.

ADD CONTACTS FOR PROTECTION

For most ranges, inexpensive non-indicating controllers can be added to electric control systems for protection purposes, to provide insurance against damage to material or personal injury, should any component of the measuring or control system fail.

Inexpensive non-indicating controllers can provide auxiliary or additional contacts to energize signal lights, audible alarms or to provide the "fail-safe" feature and shut-off the entire process when air or electric power supplies fail.

When used in this way, the set point of the auxiliary controller is adjusted at the safe-limit value, above (or below) the setting of the primary controller for the process.

The non-indicating controller would "make" only when the measured variable exceeded the correct processing value.

Non-indicating controllers added to electric control systems for these purposes are complete controllers in themselves, but function only when safe-limitations are exceeded. But these same auxiliary units have a plus value in addition to their alarm energizing or process shut-down function. For many applications, they can substitute for the primary controller when it becomes necessary to remove the primary controller from the control system for checking or maintenance. Readjustment of the setpoint of the non-indicating controller to processing values is easily accomplished. While the substitute controller does not have the recording or indicating (and possibly other desirable features) it will, in most cases, control the process satisfactorily until the primary controller can be returned to service.

Since switching action of the non-indicating controller should duplicate the switching action of the primary controller, select non-indicating controllers with spdt switching that are more adaptable than those with spst switching. When units with spdt switching perform their normal alarm-emergizing function, spst switching is obtained by not wiring to one position in the unit.

Non-indicating controllers can be used for many variables: temperature, pressure, humidity or liquid level.

TO REVERSE A pneumatic signal

Pneumatic controllers provide an output air signal which varies as the measured variable increases or decreases in value. The signal may increase (or decrease) as the variable increases. In most cases, a simple adjustment in the pneumatic controller can provide either direct or reverse signals.

Occasionally, both direct and reverse air signals are required. For example, two control valves are governed by a single controller and both must close on air failure for safety reasons. Suppose one of the two valves has a cooling function; the other, a heating function. Obviously, these two valves must respond differently to the air output signal from the controller. One must close as the other opens, and vice versa.

Installation of a pneumatic reversing relay (Fig 6) solves such a problem. The relay will decrease its output pressure in direct proportion to the increase in strength of the signal it receives from the controller. If the signal received by the relay is 0 psi, the output signal from the relay is 15 psi. When the controller sends a 15 psi signal, the output is 0 psi.

The unit responds to changes in the controlled air signals by opening and closing inner valves that shut off or open the various ports in the relay.

Averaging or Reducing Signals

When two automatic control systems in a process oppose (rather than supplement) one other, it may be necessary to convert the two systems so that they act as one system, and have equal authority over the final control element. This can be done by using a pneumatic averaging relay.

In the example shown (Fig 7), the two controllers operate two sets of exhaust dampers. An averaging relay is installed and the output signals from the controllers are connected to it. This relay then sends the

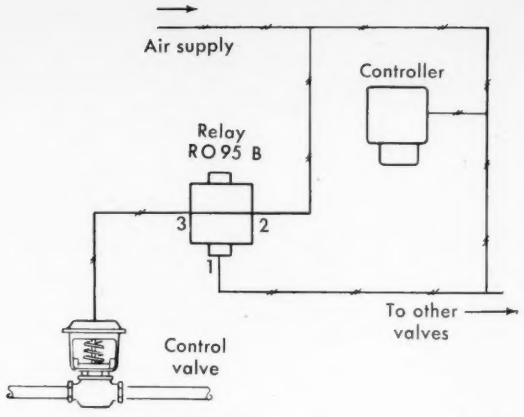


Fig 6

average value of the two signals to the motor operating the air supply damper. In this application, the averaging relay ensures that the supply air damper is positioned to admit air in proper relation to the position of the exhaust dampers.

The averaging relay can also be used in a single pneumatic control circuit to reduce the effect of the controller's output signal. For example, if operation of a valve (or pneumatic motor) through its full potential travel isn't needed, and it is required to move only through the upper (or lower) half of its open-to-shut cycle, an averaging relay in the pneumatic circuit will

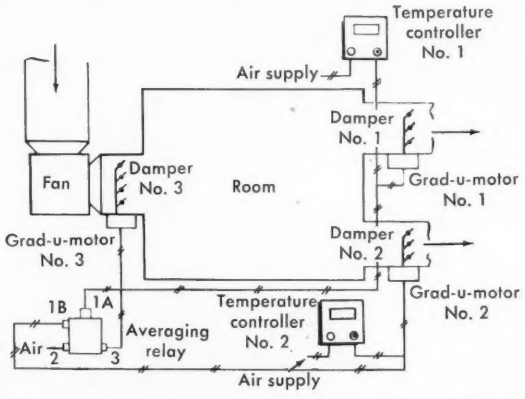


Fig 7

restrict the travel as desired.

In such a case, with one pneumatic controller involved, a constant air signal of either 0 or 15 psi is applied to the averaging relay in place of (as in the foregoing application) the signal from a second controller. If a valve is to be controlled over the upper half of its full travel (15 to 7.5 psi), the constant air supply must be at 15 psi. When the primary controller's ouput signal drops to 0 psi, the output signal from the averaging relay is 7.5 psi.

Conversely, if the valve is to be controlled over the lower half of its full-travel potential, no air signal is applied. When the primary controller's output pressure rises to 15 psi, the output signal from the averaging relay will be 7.5 psi.

This use of an averaging relay halves the effect of a total change in the primary controller output signal. By changing the value of the constant air signal, the range of operation can be changed to meet any requirement. For example, if a valve is to be controlled over 12.5 to 5 psi (instead of its full potential 0 to 15 psi) the constant air supply will be adjusted to 10 psi. Under this condition, if the primary controller output signal were 15 psi, the output signal from the controller would be 12.5 psi. If the primary controller signal were 0 psi, the relay output signal would be 5 psi.

To Select One Signal from Two

In some cases, a pneumatically-operated final control element must respond to either the stronger or weaker output signal from two pneumatic controllers. The two controllers may measure similar or different variables, with their output signal connected to a common final control element.

If it is necessary for the final control element to respond only to the controller that sends the stronger (or weaker) signal, a diverting or selective relay can be installed in the pneumatic circuit to provide this control feature.

The diverting or selective relay (Fig 8) receives the output air signals from the two pneumatic controllers, automatically selects the higher pressure signal, and passes it on to the control valve. If the signal at port 1 of the relay is greater than that at port 5, air will flow

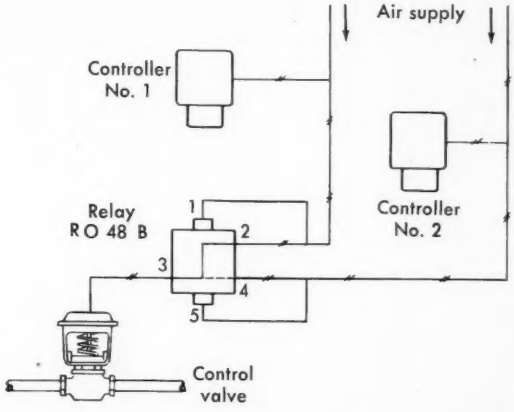
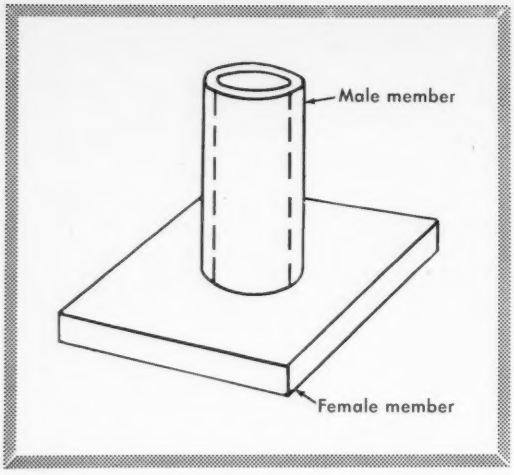


Fig 8

between ports 2 and 3. If the signal at port 5 is greater than that at port 1, air will flow between ports 4 and 3. By changing the port connections, the controller sending the weaker signal will have authority over the valve.

These examples are typical of the many easy ways of converting control systems to meet changing requirements and conditions. It is hoped that they will be helpful in solving similar problems as they arise. ★

A. O. Pearson is staff engineer, Industrial Control Devices Division of Honeywell Controls Limited, Toronto.



Brazing dissimilar metals easier now

Shown above is a common type of joint (a tube and socket assembly) in which differential expansion can be particularly troublesome. In such a joint, if the female member is the high expansion metal, the clearance (nominally correct at room temperature) may become so enlarged at the brazing temperature, that the filler metal cannot fill the joint gap. Conversely, if the female member has the smaller expansion coefficient, the clearance at brazing may be reduced so much, that the small amount of alloy drawn into the joint is either highly stressed or ruptured, when the gap tries to enlarge again as the assembly cools.

When joining dissimilar metals, it is usually necessary to braze several trial assemblies (with different initial clearances) to select the most satisfactory clearance. Much of this trial-and-error approach can now be eliminated with the help of the nomogram of fig. 2. This provides a quick method for predicting how much the joint gap will change during the brazing cycle. The method was developed by D. C. Herrschaft (assistant manager, Brazing Products Division, Handy & Harman).

Knowing the magnitude of the change, it is possible to decide whether the gap will be too large or too small for successful brazing, and anticipate how much the layer of brazing alloy will be stretched if the gap tends to expand on cooling. Stretching of the alloy layer in the brazed joint (which occurs when the male member has the larger expansion coefficient) sets up stresses that can seriously weaken the joint. On the other hand, moderate compression of the alloy layer on cooling (when the female member has the larger expansion coefficient) strengthens the joint by shrink-fit.

Rule of thumb method

The amount of internal stress that can be tolerated varies with the type of assembly, for it depends on the ductility of the filler metal and the base metals involved. A good rule-of-thumb, however, is that the layer of alloy should not be more than 50% in thickness upon cooling to room temperature. Based on the change in gap width during brazing (as indicated by the nomogram) select a starting clearance to prevent the alloy from undergoing more than 50% **theoretical** elongation when the joint cools. (Theoretical elongation assumes that all the stretch is concentrated in the filler and none occurs in the base metals.) In actual practice, some stretching does occur in the base metals (depending on ductility) due to plastic behavior while the assembly cools down from the brazing temperature. However, this provides a safety factor by relieving some of the stress on the brazing alloy layer.

A more serious problem (when brazing dissimilar metals) arises when the layer of brazing alloy is subjected to tensile stress as the reduced joint gap enlarges upon cooling. The following procedure is therefore of the greatest concern when the female joint member has a smaller expansion coefficient than the male member. The example given deals with that situation.

Using the nomogram

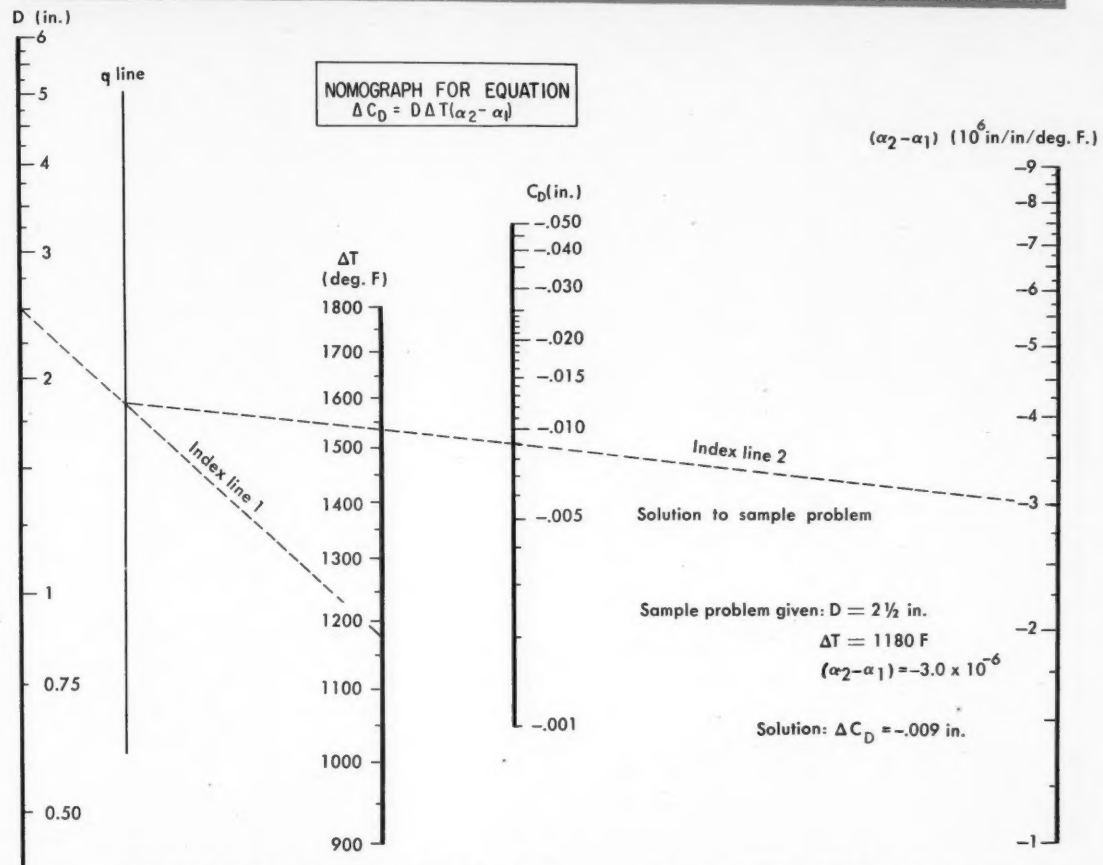
Selecting the initial room-temperature **diametral** clearance involves two simple steps. First: determine from the nomogram the amount of gap change that occurs during heating to the brazing temperature. Second: multiply the value obtained from the nomograph by 3. This establishes the room-temperature diametral clearance which will restrict the amount of stretch in the solidified brazing alloy to a theoretical elongation of 50%, the ideal maximum. The results of this method are not exact, but they do give a good starting point for brazing a trial assembly.

The nomogram is based on the equation shown. It provides a working approximation of the gap change in a tube-and-socket type assembly of specified diameter and base metals, when heated to brazing temperature. ★

There is often a tricky brazing problem with dissimilar metals, because the different parts of an assembly don't expand equally during the brazing cycle. Because of unequal expansion, the joint gap at the *brazing* temperature can be quite different from its dimension at room temperature. If proper allowance is not made for this dimensional change in the specified joint clearances, the brazing alloy may not provide a satisfactory joint.

Design Engineering DATA SHEET

Brazing Joints



Here's how to use the nomograph to find $\triangle C_D$ and then select the diametral clearance to limit the theoretical elongation to 50% when the male member has the higher expansion coefficient.

Problem. A 2½-in. diameter cartridge-brass tube is to be brazed into a carbon steel plate using BAg-6 filler metal. Select the room-temperature clearance for the first trial braze.

From a metals handbook:

α_2 (carbon steel) = 8.61 x 10^{-6} in./in./deg. F. (mean coeff., 75 to 1200 F)

α_1 (cartridge brass) = 11.60 x 10^{-6} in./in./deg F (mean coeff., 75 to 1200 F)

Solidus temperature for BAg-6 = 1250 F

The working values are therefore:—

D (nominal diameter) = 2½ in.

Net temperature change in brazing cycle $\triangle T$ = 1250 -70 = 1180 F.

$(\alpha_2 - \alpha_1)$ = (8.61 — 11.60) x 10^{-6}

= —2.99 x 10^{-6} in./in./ deg. F

Solution:

(1) Lay off index line 1 connecting the 2½-in. value on the D scale and the 1180 F value on the $\triangle T$ scale.

(2) From the point where index line 1 intersects the q-line, extend index line 2 to the value —2.99 x 10^{-6} on the $(\alpha_2 - \alpha_1)$ scale.

(3) Where index line 2 intersects the $\triangle C_D$ scale, read the resulting change in diametral clearance. The result is —0.009 in., indicating that the diametral clearance will shrink by that amount when the parts are heated from 70 to 1250 F.

(4) Multiply $\triangle C_D$ by 3 to give a 50% theoretical elongation in the filler metal on cooling. Desirable initial diametral clearance = .009 x 3 = .027 in. (or .0135 in. radial clearance). This represents a good starting point for the first trial braze.

It should be emphasized again that the theoretical percentage of elongation calculated by this method may be higher than actually occurs in practice, because of plastic deformation of the base metals as they cool down from the brazing temperature. Where the ideal 50% theoretical elongation results in too large a gap to braze satisfactorily, try starting with a smaller room-temperature clearance. Although the theoretical elongation will increase as a result, the joint strength may still be adequate for the application. In some cases, a more sluggish brazing alloy will solve the problem of filling the large gap. If the substitute alloy melts at a substantially different temperature, a new $\triangle C_D$ must be determined from the nomogram, based on the different solidus temperature. Certain combinations of base metals in large diameter joints may result in so large a gap change, that brazing becomes impractical.

In cases where the nomogram cannot be read with sufficient accuracy (or one of the variables is off the scale) the value for $\triangle C_D$ can be calculated from the equation given.

Some tips on how to draw press tools

Drawing of the die is an important part of the creation of a press tool — don't leave it to the toolmaker to try and fathom things out for himself.

Federico Strasser

The successful creation of a press-tool is the result of good team-work. Every member of the team (from the component designer, through the tool engineer, up to the toolmaker) contributes his share.

An important phase of the process is in the drawing of the die. This short article presents what my personal, practical experience has taught me to be correct in this respect.

To avoid the repetition of common knowledge, standard mechanical drafting practice at large will not be discussed, but only details related specifically to press-tools.

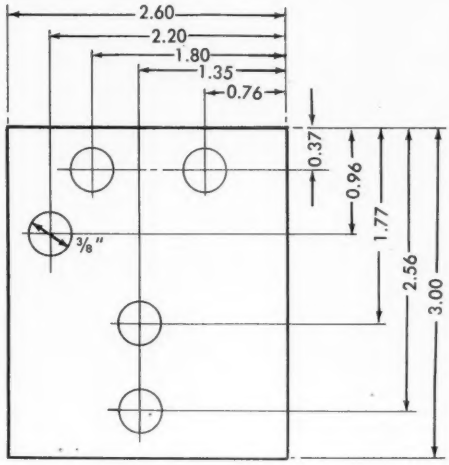
It is a well-justified wish of any toolmaker to receive drawings of press-tools, with every detail clearly defined and specified. It is not right to expect him to spend time on mathematical or trigonometric calculations; or to meditate on the interpretation of ill-defined specifications; or to make decisions about missing details or those left to his judgment.

How to draft press tools

(1) The dimensioning of die-plates (and, for that matter, of any other die member) should be made according to the modern way of rectangular co-ordinates. That is, the dimensions must be given from a base line (or finished surface) as in Fig. 1. In the case of symmetrical die-plates, a centre line is taken as the base line.
(2) The longitudinal cross-section usually shows the die in the open position. Sometimes, however, if some functional detail must be shown in both open and closed positions (as may be the case with forming or drawing dies) the punch is divided by the centre line and the tool thus drawn in both positions (Fig. 2).
(3) To save time, screw-threads and holes for dowels and stop-pins may be omitted. They are then simply shown by their centre lines and their dimensions (and other characteristics) written on the drawing directly (Fig. 3) or given in the specification list.
(4) Angular clearance of the cutting openings (Fig. 3) must be specified accurately, and not left to the toolmaker. Punch clearances must also be indicated exactly.
(5) If corners are rounded (as they should always be) specify the value of the corresponding radii (Fig. 4).
(6) Don't put on the same sheet both the assembly and the part drawings of the same tool. They should be on separate sheets.
(7) The finished workpiece should be reproduced in a corner of the assembly drawing. This is necessary, especially in the case of multi-stage progressive type dies, where the appearance and dimensions of the finished component is not always apparent from the tool drawing itself.
(8) The rounding radii of the forming edges in both bending (Fig. 5) and drawing dies (Fig. 6) must be specified exactly. The same goes also for the forming edge radii of the corresponding punches.
(9) If springs are foreseen (for holding or ejecting purposes) their characteristics (type, load capacity, dimensions, travel, etc.) must be detailed.
(10) In forming dies, springback must be taken into account. If it should be compensated by overforming, then indicate on the drawing the actual tool angle, and the probable angle the workpiece will have after it has left the tool.
(11) In forming tools, indicate the position of the burr-side of the flat blanks (it should always be against the forming punch (Fig. 7).
(12) In both forming and drawing dies, indicate the approximate size of the necessary flat blanks, but state clearly that the dimensions and shape are only **approximate** and must be checked and corrected by practical tests.
(13) In drawing punches, specify the size of the air vent holes (between 5 and 15% of the OD of the punch, Fig. 8).
(14) The specification list should carry all the basic and supplementary information for the tool to be built easily and quickly as follows.

Important data

(a) Type and size of press to which the tool in question will be destined; its stroke (if variable, the limit values); shut height of tool; dimensions of shank; size of holding boltholes for fastening the die on the bolster-plate or directly on the press-table; size and location of eyebolts for handling the tool.
(b) Quantity, basic dimensions (both rough and finished) of the tool-members; quality and type of steel from which to make them, machining and heat treatment data (hardness range).
(c) The material employed for the component; its type, thickness, temper, origin (sheet, coil or strip), and lamination direction (especially important if further forming operations are likely).
(d) Number of stampings to be produced.
(e) Whether the part is an individual component or must be assembled to others (and if so, which ones).
(f) Tolerances for tool-members and finished part. ★



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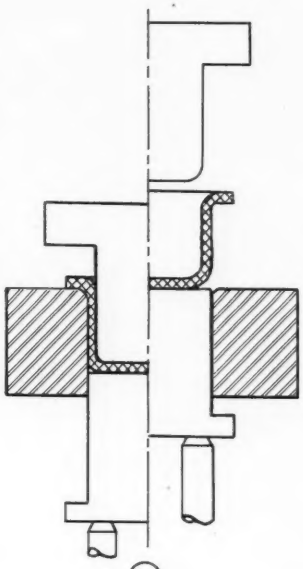

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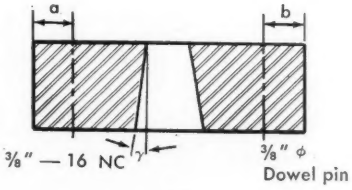

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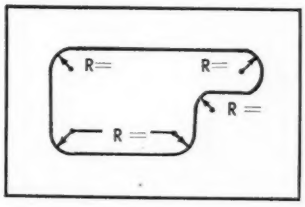

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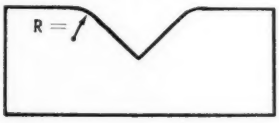

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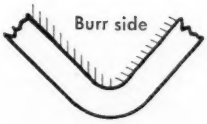

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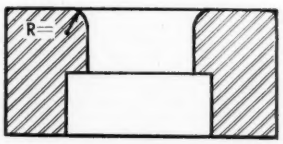

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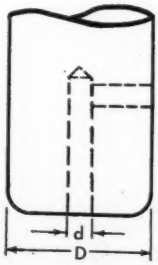
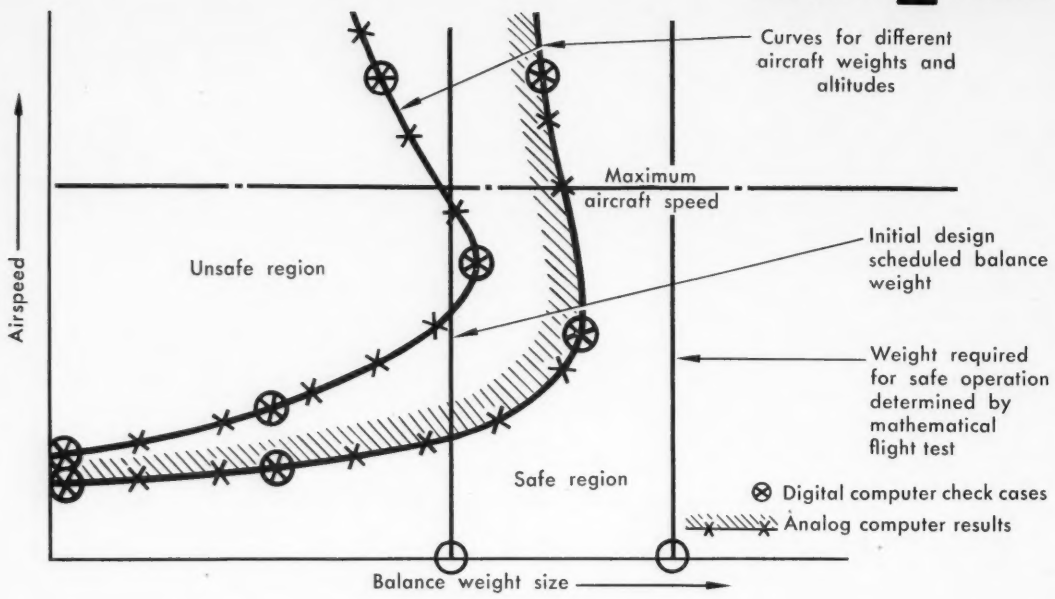


⑧ d = 5 — 15% D

Exclusive DE Feature


Curves for different aircraft weights and altitudes
Maximum aircraft speed
Initial design scheduled balance weight
Unsafe region
Airspeed
Weight required for safe operation determined by mathematical flight test
Safe region
Digital computer check cases
Analog computer results
Balance weight size

Mathematical flight testing in design

This mathematical flight test enabled experts to make any necessary changes in the suggested design long before component parts were built

A valuable area in the mathematical flight testing of an aircraft (in which automatic computing machinery serves) is the determination of aero-elastic stability. Above certain flight speeds, structural vibrations can become self-generated and build-up rapidly to the point where total destruction of the aircraft could result. The necessity for the correct predetermination of these speeds is thus self-evident, but there are further important considerations. For example, there are no simple design criteria for determining these speeds, and the mathematical expressions could take man-years to calculate. The only alternative would be a lengthy, hazardous and extremely costly flight-test program, embodying any aircraft modification necessary as the program progressed.

In the mathematical method, an analog computer is "flown" through the aircraft speed range, and the design characteristics changed until a safe performance can be shown throughout the entire operating regime of the aircraft.

A mathematical model is employed on the computer to solve the following flutter equations, which define the aero-elastic stability problem:—

$$\{ [a]_B + \sigma [a] \} \{\ddot{q}\} + \{ \sigma [b] v + [d] \} \{\dot{q}\} + \{ \sigma [c] v^2 + [e] \} \{q\} = 0$$

Here, $[a]_B$, $[d]$ and $[e]$ are properties of the structure.
$[a]$, $[b]$ and $[c]$ are aerodynamic properties.
σ is the altitude of the aircraft.
v is the forward speed of the aircraft.
and $\{q\}$ are the modes of vibration of the aircraft structure and control surfaces.

Because the importance of correct results cannot be minimized (either from the point of weight penalty or aircraft safety) the results from the analog computer are checked by taking certain cases and evaluating them on a digital computer.

A typical result is shown above which indicates the design changes required on the Argus aileron mass-balance.

This shows that (for the initial design scheduled balance weight) as airspeed increases, we pass from a "safe region" (where any induced vibrations of the aileron would damp out) to an "unsafe region" (where oscillations would quickly and uncontrollably build up to destruction). The significant feature is that this speed is well below the maximum aircraft speed. It is not until the balance weight is increased that the airspeed can go up to (and beyond) the maximum design speed and stay entirely within the safe region.

The curves marking the boundary between "safe" and "unsafe" were obtained by using an analog computer. Two curves are shown, to indicate how the position of this boundary alters for different flying weights and altitudes. Spotted on this curve are the check points obtained by digital computer.

Thanks are due N. P. Shevloff and K. W. Toulson of Canadair Ltd. for the information in this article.

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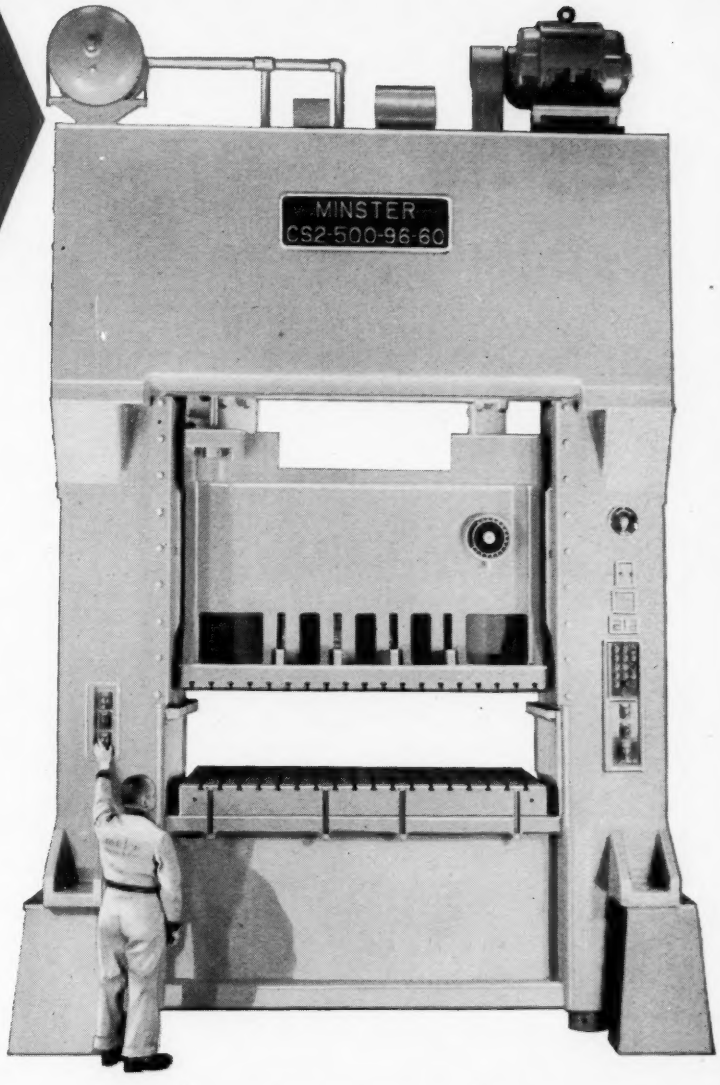

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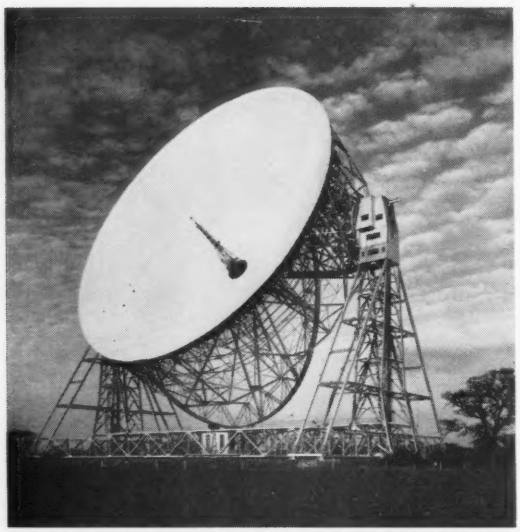
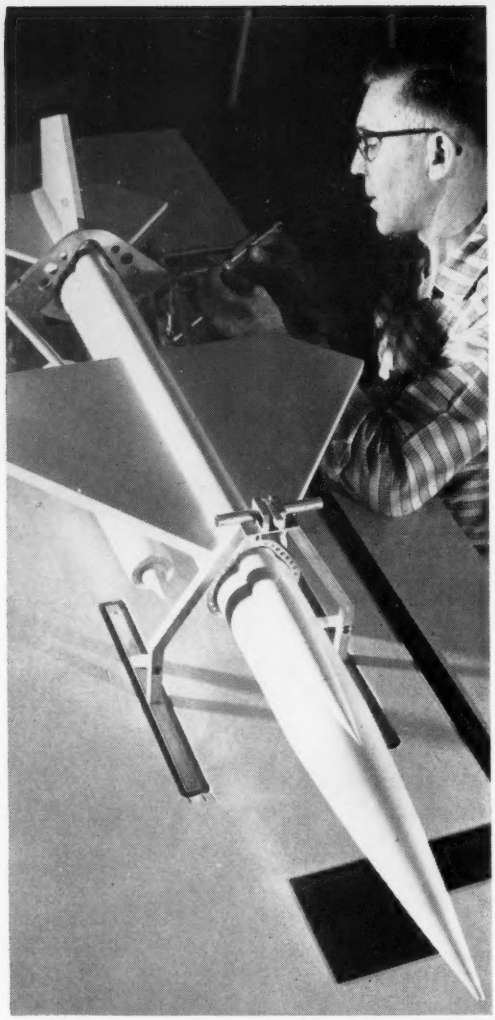
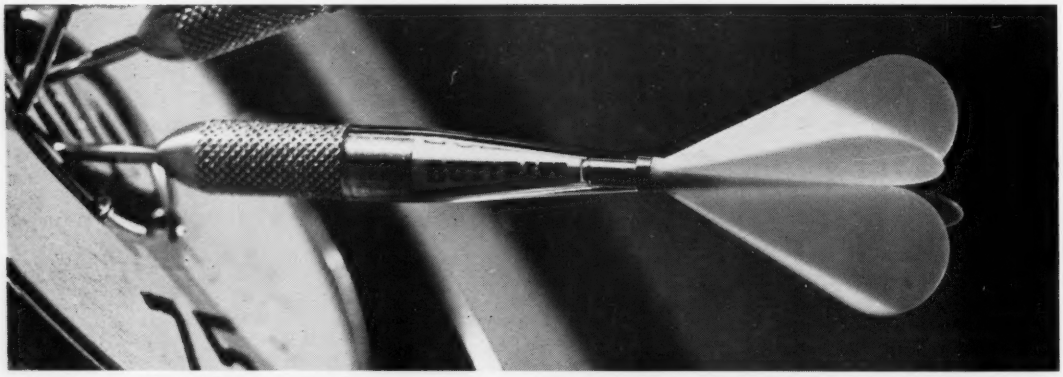
Design News in Pictures



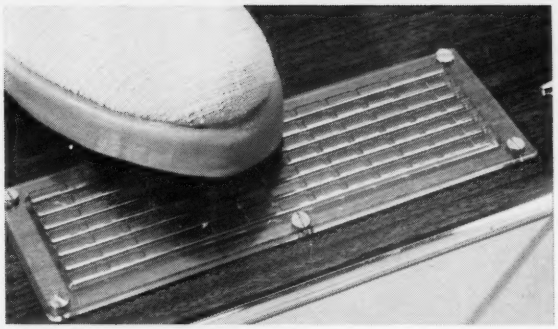
200—The Jodrell Bank radio telescope can be driven to counteract motion of the earth when plotting stars. The 'scope weighs 2,000 tons, revolves on track 360-ft. dia.



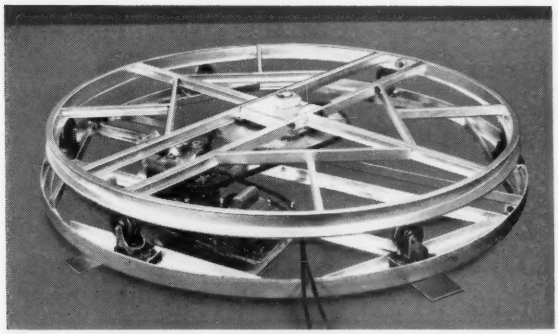
201—Notice the harness on this model missile. It was designed and built to test advanced Bomarc interceptor missile. Will use solid, not liquid, fuel.



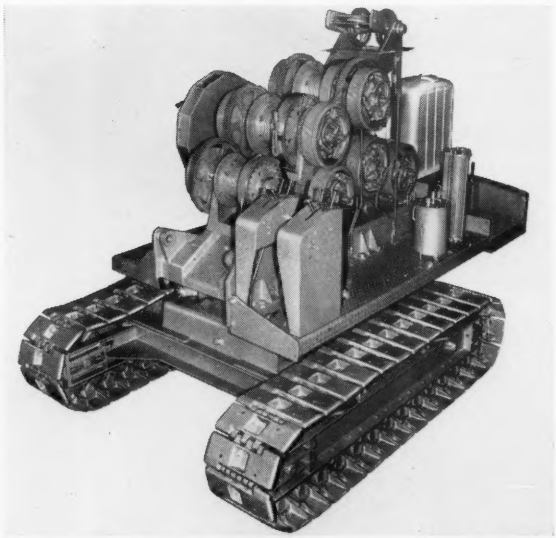
202—Darts with a difference. Shanks are made of carefully tooled brass with flight holders of tough, butyrate plastic. Revolving flights or fins of polyethylene are replaceable. And every dart is guaranteed for twelve months.



203—Cleated step plate is the point of interest. It is molded of transparent plastic, and screwed to gunwales, gives firm foothold at some vital points of a small craft.



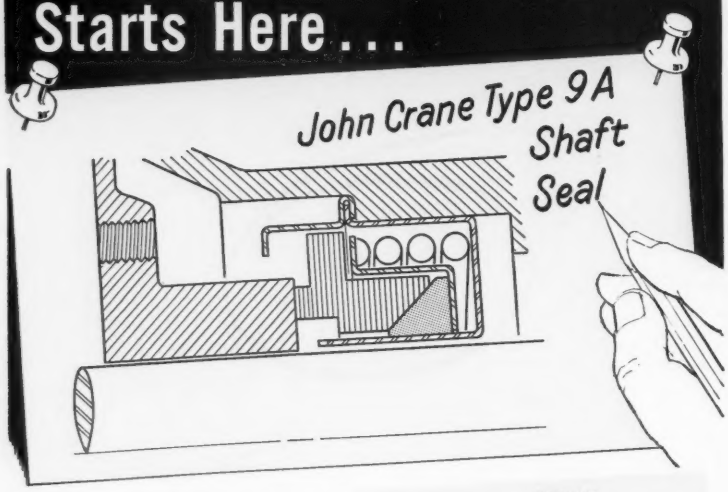
204—New low-cost turntable goes together with just 12 bolts—can be assembled by a two-man crew in less than half an hour. The 16-ft. diameter size has three-ton capacity.



205—This is the machinery layout of a new ¾-yard shovel-crane. Separate power flow is provided for each function: notice three drums fully equipped with reversing clutches. Machine has completely independent swing-and-travel action

206—Tall tower is self-supporting and one of nine in microwave system. Up to 100 mph winds in area dictated special anchoring methods for the tower's erection.

Sealing Corrosive Liquids Starts Here...

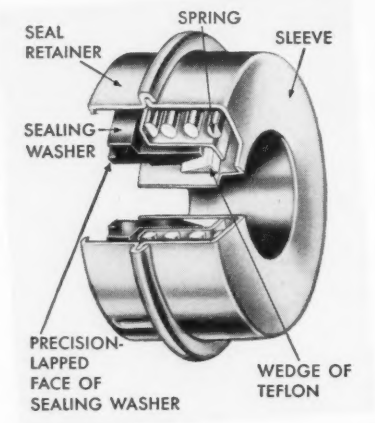


This cartridge-type shaft seal designed for the production line is engineered for:

(1) positive sealing of many industrial chemicals and solvents (note the Teflon* sealing wedge);

(2) leakproof handling of inflammables and toxics;

(3) operation over a wide temperature range from −120° to +500°F., pressures to 150 psi.



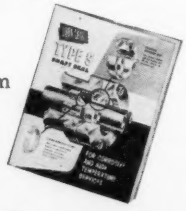
It offers the Original Equipment Manufacturers these important advantages:

(1) low unit cost through mass production;

(2) fast, one-piece installation through cartridge construction;

(3) equal efficiency on both low or high speed applications, because seal does not rotate with shaft.

The 9A Shaft Seal can be of stainless steel, monel, brass or other materials adapted to stamping and forming—depending on the service requirement.



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Briefs

We note with interest . . .

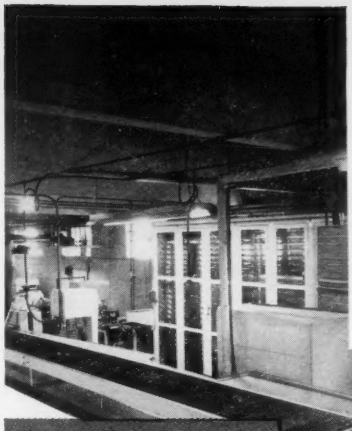
that a "dead-man's throttle" which automatically stops a train in seconds, freight cars that float on water and wheels that don't need sand to get traction on hills are current European advances . . . **production of** polyethylene film has begun at Du Pont of Canada's Whitby, Ont., plant . . . **a firm in** San Gabriel, Calif., has developed a phosphor escent paint that charges itself from natural or artificial light during the day so that it will glow during darkness . . . **Uncle Sam is** investigating building a light tank that can lift itself up to five feet off the ground and scoot up to 200 mph on a high-pressure wall of air blasted downwards . . . **Alcoa are wooing** industrial design students with establishment of free use of technical library, free aluminum for okayed projects and aluminum seminars . . . **Le Ripolin** of Paris have licensed the Glidden Company to manufacture and distribute the French company's line of boat paints . . . **the international** conference on Non-Destructive Testing will be held in Tokyo, 1960—a rare chance to make a constructive appraisal of geisha girls . . . **now on the market** is a portable magnetic inspection system for detecting surface and subsurface defects in ferrous metals: twist is that it demagnetizes the part after inspection . . . **because most** plastics are stable up to about 300 deg. F, a molecule which may lead to the development of heat-stable plastics is interesting information . . . **close your ears** — we're blowing the trumpet again. At the American Music Show in New York recently the stereophonic hi-fi designed by **David Gilmour** and **Peter Monk,** two young Toronto industrial designers, wellnigh stole the show from under the noses of American counterparts, and sold 25 sets in three days from photos alone (Their Clairtone set won an NCID Award for 1959) . . . **we hear that** Inco will build a $25 million nickel refinery at Thompson, Man. . . . **seems everybody's** getting into the box-lunch business these days: another tid-bit on the industrial menu is an aluminum-foamed plastic structural sandwich . . . **got set back** on our heels a bit when we discovered that Bell Laboratories, the research and development organization for

(Continued on page 59)

Briefs *(Continued from page 58)*

Bell System, employs nearly 11,000 people at 18 locations in 10 states (watch out for your July issue of DE devoted to R & D in Canada) . . . **a paper presented** at the 63rd Castings Congress of the American Foundryman's Society, April 17 by D. V. Doane revealed that outstanding wear reduction has been achieved on grinding equipment parts through the use of 15-3 alloy . . . **anything can happen** these days: a firm of consultants has devised a 20-minute test that "detects in advance the kind of worker most likely to cause repeated injury to himself and others — is a big aid to job placement." We're volunteering for the test in hope of acquiring lifetime exemption from washing-up . . . **just off the skids**—a new group of low-melting glass composition said to have far-reaching implications in the manufacture of moisture-sensitive devices . . . **Dates for your deskpad: June 7-13** in Quebec City or **June 14-20** in London—Management Development Course sponsored by the Canadian Council of Foremen's Clubs **June 8-10** in Montreal—American Management Association **June 14-18** in St. Louis, Miss. — Semi-Annual Meeting of the American Society of Mechanical Engineers **June 16-20** at MIT — Industrial Photoelasticity **July 7-11** Fundamentals, **July 13-17** Applications re strain gauges, both courses at MIT . . . **the U. K. is** dickering with Canada for the purchase of five completed Arrow Mk 1's apparently for testing purposes . . . **next time you blow** your muffler — have it chrome-plated and polished and hang it on the fireplace wall of your den. No we haven't gone nuts — just heard that stainless steel mufflers are likely to be a reality soon . . . **OCDRE** (Organic-Cooled, Deuterium-moderated Reactor Experiment) is a different reactor in that an organic liquid rather than heavy water is used to transfer heat from the uranium fuel to the steam generators. Heavy water is still to be used as the moderator and the fuel will be natural uranium . . . **we hear that** GM Plastic Co. is installing an advanced type of nuclear and electronic instrumention to automatically control the gauge of sheet coming off the extruder . . . **tomorrow's supersonic** passenger aircraft may be equipped with turbojet boosters for take-off and ramjet engines of high cruising speeds . . . **we'd hate to be** responsible for ordering 3,475 tons of a new wrought iron over the telephone. Its name is "Mn" . . . **this item** is dedicated to

(Continued on page 62)



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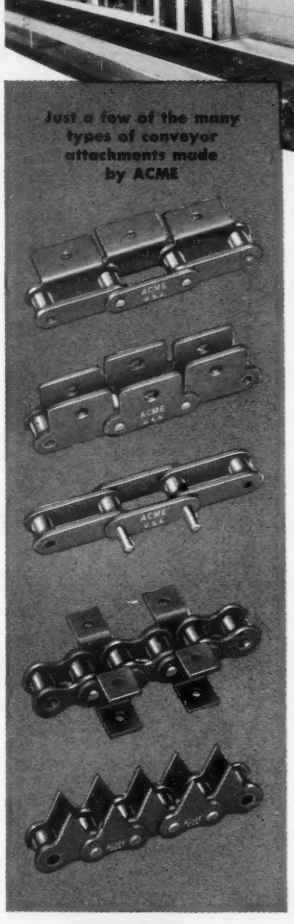

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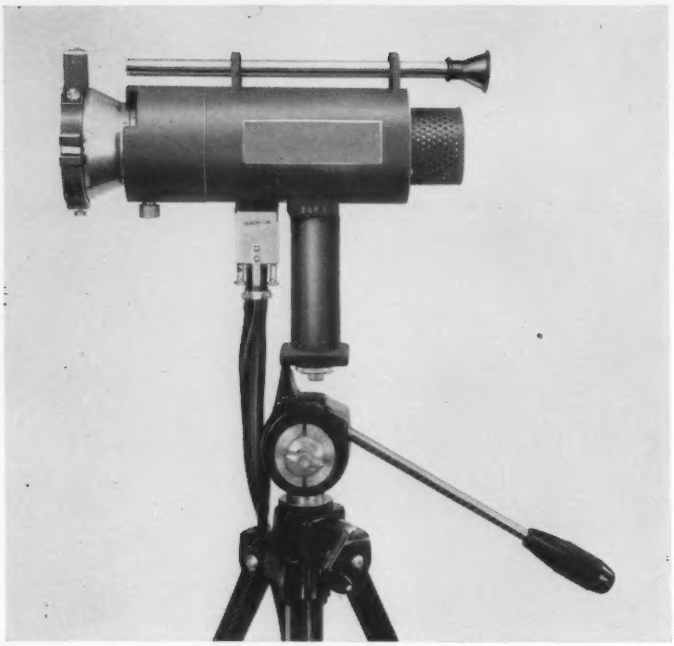

Fig. 1. This is the sensing head of the infrared radiation pyrometer.

Process control by infrared radiation

In any process where heat is used in any manner, for any purpose, there is room for improving process control with a pyrometer control system

Sabert Howell *and* **Joseph Jerger Jr.**

Control systems based on infrared radiation collect (by means of a sensing head) infrared radiation and convert it into a proportionate electrical signal. This signal is then amplified so that it can operate meters, indicators, recorders or automatic control devices.

Infrared radiation pyrometers are easily applied to the process control needs of the basic industries listed below, and to their related operations.

Primary metals industries
Temperature measurement and control of ferrous and nonferrous metals in sheet, bar, roll or tubing, under-going extrusion, molding, casting, drawing, rolling, oven heating, melting, die-casting, induction heating, heat hardening, annealing and heat processing.

Metal fabrication
Temperature measurement and control of metals undergoing induction hardening, machining, forging, brazing, cutting, boring, stamping, forming and so on.

Mineral, ceramic and glass products
Temperature measurement and control of mineral processing, crystal growing, glass forming, ceramic firing and annealing temperatures.

Emission of infrared radiation is a characteristic of any material object whose temperature is above absolute zero (—459 F). The specific peak-wavelength of this radiation is a function of the temperature of the object. Between absolute zero and 1,800 F, over 99.9% of the radiation is in the infrared region. Fig. 3 shows the relative energy of the radiation plotted against wavelength for a blackbody (perfect radiator) at temperatures between 20 C and 920 C. These curves are derived from the three basic relationships of total radiation to temperature: the Planck equation (defining the spectral distribution of radiant energy), the Wien displacement law and the Stefan-Boltzmann law of total radiation.

Note that 75% of the total energy (represented by the area under the curves) is on the long wavelength side of the radiation maximum, and that most of the energy is at wavelengths greater than one micron. For example, at 1,000 C, less than 0.5% of the total energy is below that wavelength. At lower temperatures, considerably less total energy is available, and the distribution shifts to longer wavelengths.

The Servotherm infrared pyrometer, Model 1372 (Fig. 1) consists of a sensing head and a self-powered amplifier. This general purpose unit, designed especially for industrial applications, covers a range of temperature variation from 120 F to 2,800 F with the apertures normally supplied. Because of its fast response, the pyrometer can be calibrated to measure and control

the temperature of objects in motion with an accuracy of ±1%. It maintains calibration under the ambient conditions in manufacturing plants, and its output can be fed directly into heat and power control systems.

In operation (Fig 4), incoming radiant energy is collected by the Servofrax lens, and, after interruption by the mechanical chopper at a 15 cps rate, is focused on a bolometer heat detector. This radiant energy is compared with similarly interrupted energy from an internal reference radiation source via a second bolometer, bridge-connected with the first. The bolometer bridge is biased with d-c voltage balanced to ground. The cyclic interruption of the energy produces cyclic variations of the bolometer resistances. Any difference in energy level between incoming and reference radiation produces an a-c voltage output from the bridge to the preamplifier grid. The phase of this output voltage depends on which radiation level is higher.

Before it is fed to the amplifier unit, the output is rectified by a synchronous rectifier on the chopper shaft. This produces a d-c voltage polarity-sensitive to the energy levels. A source hotter than the reference produces a positive voltage, while a source colder than the reference produces a negative voltage.

The internal reference source is used to null the incoming radiation, making it possible to use full amplification for high differential sensitivity. Once the pyrometer is set for a given temperature, small deviations from it appear as relatively large voltage outputs, which may be used for manual or automatic control. The range of the standard instrument is from 120 F to 1,830 F. Use of a cooled reference source permits measurements down to (and below) ambient temperature.

The meniscus collecting lens is an f/1.25, 2-in. diameter unit, made of arsenic-trisulfide glass. This is the first material available for far-infrared transmission that does not require special mounting or handling, is impervious to most chemicals, and has the other desirable physical properties of a true glass. ★

Messrs Howell and Jerger are staff engineers with Servo Corporation of America, working on infrared systems.

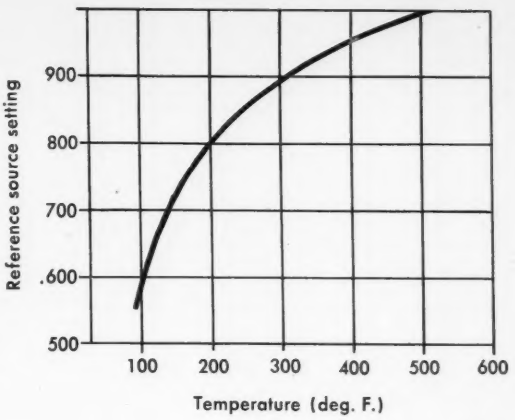

Fig 2

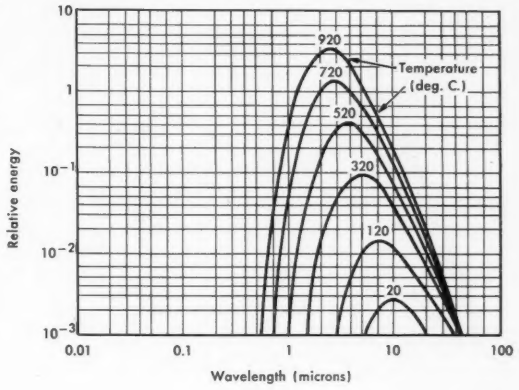

Fig 3

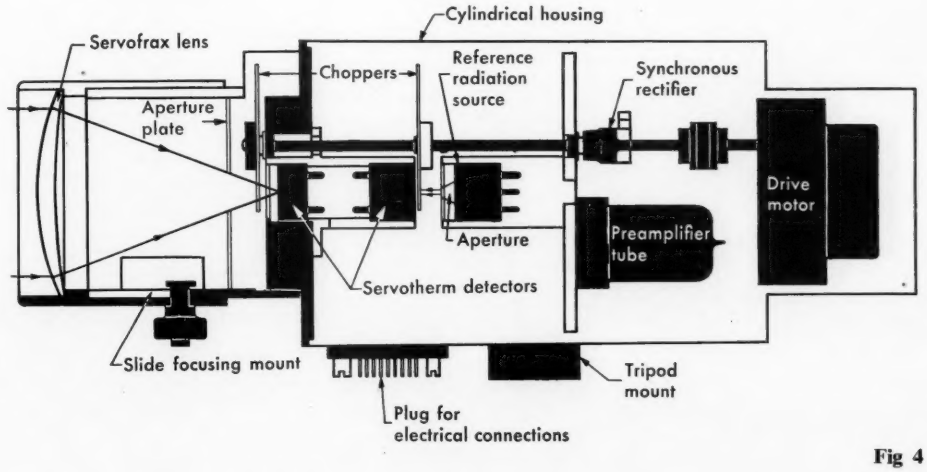

Fig 4

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Briefs *(Continued from page 59)*

bachelor engineers — the days (er, ah nights) of putting your pants under the mattress for a press are over. Now you just spray a new chemical on your trousers, iron once over lightly and presto! your crease will endure the wildest stag party . . . **Europe is** really throwing new model autos at us these days: in recent weeks we've noticed heavy national advertising for four comparatively unknown makes of cars . . . **Brief talepiece** — You may have seen some of the current adv. — (beg pardon, announcements) for the Rolls-Royce which tell how every nut and bolt is chromium or cadmium plated, that there is enough leather in the upholstering to make 128 pairs of shoes and that at 60 mph the loudest noise comes from the electric clock. We like the comment attributed to one of the senior RR engineers when he read this last statement: "We really must do something about that clock." ★

Letters to The Editor:

To The Editor

Last November I wrote asking for information on a radiant heater, gas fired, which I thought I had seen described in **DE** though I could not remember when.

You were kind enough to look into this and, since you were unable to locate the particular reference, put me on to General Electric who make an electrical heater of a similar type.

Since then I have located the unit and find that it is made by Hupp International of Cleveland, Ohio, represented in Canada by Quail Products Ltd., 80 Duchess Street, Toronto. It is called Perfection-Schwank Infra Red Generator.

One big advantage for us is that it avoids a large continuing demand charge for electricity and consumes gas only when it is used. As this will be for only a limited season, it should be much more economical.

In the hope that this information may be of interest to you I pass it along.

(Letter received from C. H. Conroy, P.Eng., Chief Engineer, Dept. of Public Works, St. John's, Nfld.)

The increasing use of plastic premixes

A roundup of some of the products made from reinforced molding materials illustrates the versatility of premixes. They take to volume production.

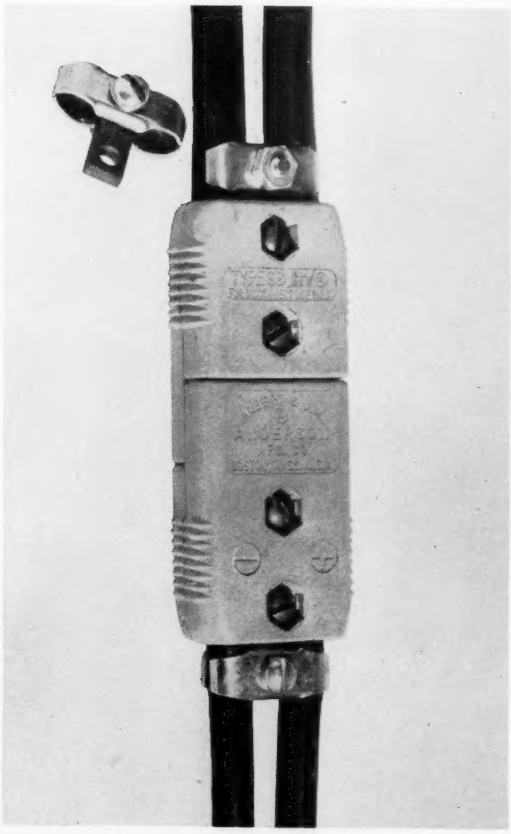

Fig. 1—The excellent dialectric properties, good resistance to chemicals and moisture that characterize alkyd resins and the impact strength from fibrous reinforcement, combine in compact electrical connection.

During the last six years, reinforced molding materials or premixes have become popular when cheapness and high strength are required. They lend themselves to volume production, with standard compression and transfer.

The plastic resin, reinforcement, fillers and pigments are premixed by the materials manufacturer or by the molder himself. In either case, the material reaches the press ready for molding. Separate handling of the reinforcement, the filler and the resin (characteristic of other reinforced plastics) is unnecessary.

These premixes have a high strength-to-weight ratio, excellent electrical properties, good chemical resistance, imperviousness to rust and rot, low thermal conductivity and built-in-all-through color. They can be formed into one-piece shapes (difficult or impossible with other materials); can be given form, color and finish in one operation; and the tooling costs are low.

Because they use short, chopped glass fibres for reinforcement, they do not have the strength of the reinforced plastics that use woven fabric, mat or preform as a reinforcement. Allowance can be made for this, however, by having thicker sections at points of higher stress; by ribbing; by using beaded edges; and by increasing the ratio of glass to resin and filler.

Further tailoring to meet the particular requirements of a specific product results from varying the type of resin and reinforcement. While polyester is the resin most generally used in these molding materials (as in all types of reinforced plastic), phenolic may be used instead to give the material better heat-resistance, good mechanical strength and electrical and chemical resistance. Epoxy resins impart superior chemical resistance, low water absorption and cure shrinkage, with exceptionally good adhesion. Other resins commonly used in premixes are the alkyds and silicones.

Instead of chopped fibrous glass as a reinforcement, asbestos may be used, particularly when high heat resistance is needed. Sisal and metal are other reinforcements used in these premixes for special reasons.

Some of the products now being made from these reinforced plastics molding materials are shown here. ★

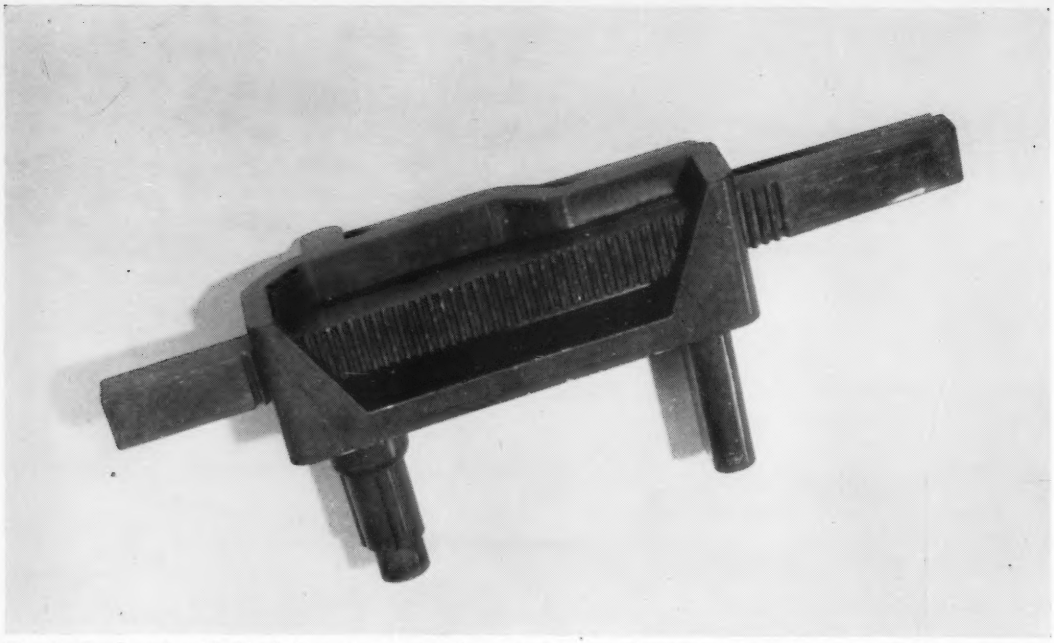

Fig. 2—Rack and guide block for water purification system from chemical resistant premix molding compound.

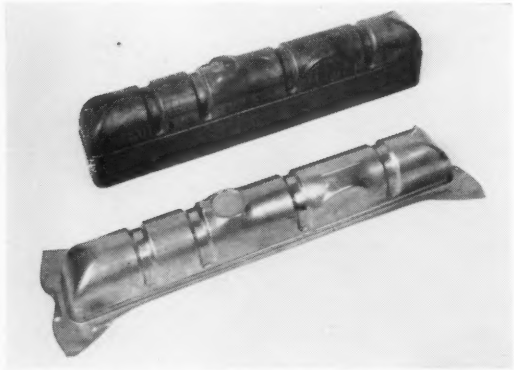

Fig. 3—The ES punch above produces the stamping underneath. The part is an automotive radiator tank top.

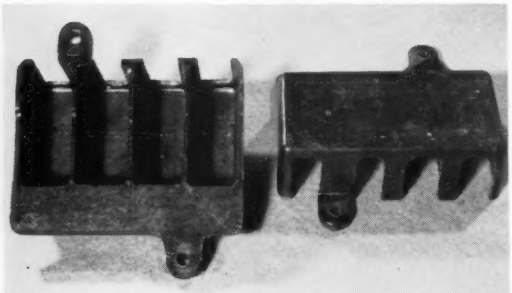

Fig. 4—This junction box is molded from a glass-reinforced, silicone compound, resulting in high strength, good long-time mechanical properties above 500 deg. F. and excellent electrical and chemical features.

Fig. 5—Redesigning of an industrial-type indicating temperature control featured use of a glass fiber reinforced polyester molding compound. The new control has better appearance, high impact strength, dimensional stability, color fastness, smooth texture and resistance to high ambient temperatures, apparently.

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- ☐ Brazing dissimilar metals easier now
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- ☐ Process control by infrared radiation

New Products and Literature

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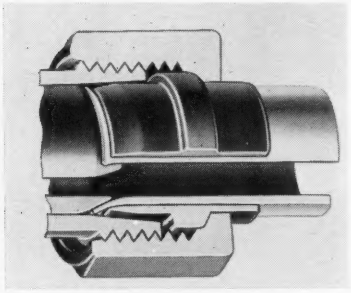
New products & materials

Self-flaring tube fitting

A self-flaring tube fitting has been developed by the **Flodar Corporation.** It employs a hardened steel sleeve to press the tube into the contoured body to form a flare as the fitting is tightened. In so doing, the fitting forms a pressure tight seal on both the OD and ID of the tube.



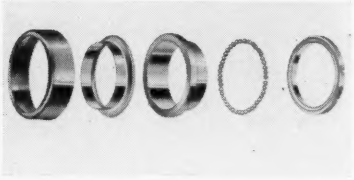
A slotted skirt on the rear of the sleeve supports the tube absorbing excess vibration.

In tightening the fitting, the nut comes to a "rock bottom" stop as a perfect seal is effected thus, preventing overtightening, a serious hazard on the flareless type of fitting. Because of the nature of the seal obtained the fitting can be reused without danger of leakage.

Fittings are available in all standard tube sizes from ⅛ in. to 2 in. and all common styles. **(216)**

Rotation joint

Designed for airborne use, Marman Rotation Joints are lightweight (2¼ in



joints, without flanges, weigh less than a pound), corrosion resistant, and have had leakage rates actually less than demanded by specifications, say makers. Used between sections or systems which are hinged or rotate about each other, they maintain complete integrity over thousands of pressure cycles. Pressures as great as 390 psi and temperatures from —55 deg F to +735 deg F can be safely accommodated. Joints are capable of full 360-deg rotation, and stainless steel ball-bearing design provides extremely low breakaway torque. The **Aeroquip Corporation** are the manufacturers. **(217)**

Lever operated Valve

These "Slim line" valves are streamlined in appearance; and can be mounted easily on machines and machinery even when space is extremely limited. They are suited for air, oil or water service; pressure to 125 psi; temperatures to 150 deg F, and are available tapped for either ⅛-in. or ¼-in. pipe connection.

The valve housing is milled from solid

aluminum bar stock. The valve cham-

(Continued on page 77)

Circle number 145 on time saver card

Ideas round-up

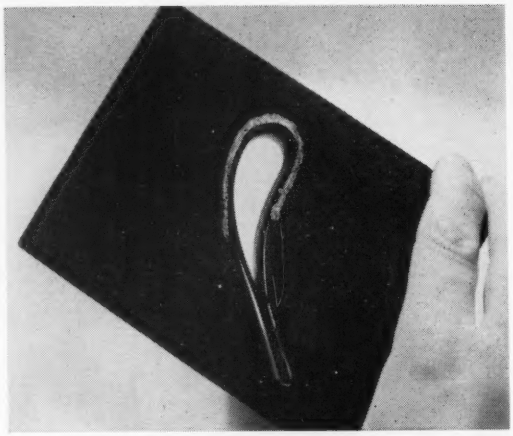
Brazing alloy: made for large clearances

There is a new brazing alloy (W. G. Nicrobraz) for high-temperature service, especially developed for use with large clearances up to 0.050 in.

The material (developed by the Stainless Processing Division of Wall Colmonoy Corp.) has been thoroughly production tested. It is recommended for use in non-rotating, lightly-loaded parts and structural assemblies that have a cross-sectional thickness of 1/16 in. or more. It is very suitable for applications where large brazing fillets are desired.

When used as recommended, an excellent braze is produced in gaps up to 0.050 in. between mating components. Its excellent wetting characteristics, good alloying effect and high viscosity factor produce strong rigid joints. Fit-up tolerances can be relaxed when this material is used. This means greater design flexibility and lower production costs.

(207)



Servo valve: compact and lightweight are its design features

Lightweight and compact electro-hydraulic servo valves (designed to meet the stringent requirements of aircraft and missile hydraulic servo systems) are now available from Pesco Products Division, Borg-Warner Corporation.

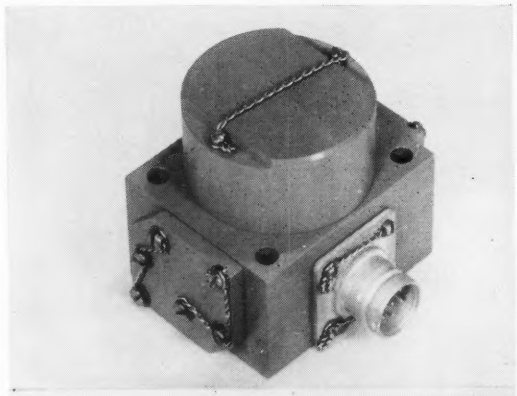
The valve is a proportional flow control unit. It operates on a dynamic continuous flow sensing principle, made possible by the flowmeter design. It has fast response, low internal friction, minimum null shift, faithful reproduction of small input signals and insensitivity to variations in temperature and load or supply pressures.

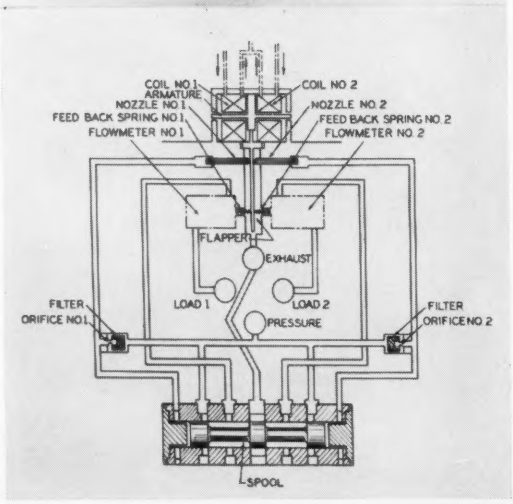
These servo valves are available for rated flow capacities from ½ to 7 gpm, and can be designed for use with any required system pressure of 500 psi or higher.

The unit consists basically of a dry-coil torque motor, an hydraulically-balanced flapper-type pilot valve, a 4-way, slide type power valve and a flowmeter feedback loop.

Careful design has produced a valve that is compact and lightweight. Total envelope for each model in the line is less than 10 cu. in. The weight is about 11 oz. The valves will operate at ambient temperatures from minus 65 F to plus 450 F and fluid temperatures from minus 65 F to plus 400 F. The drawing shows the relation of the basic components.

(208)





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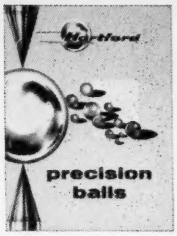

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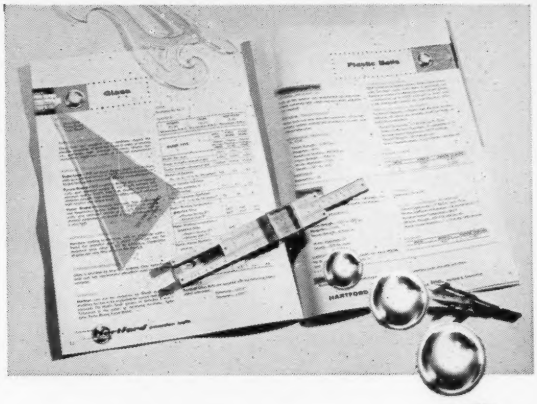

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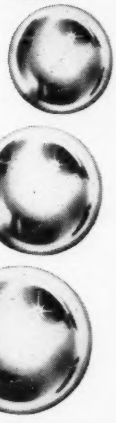

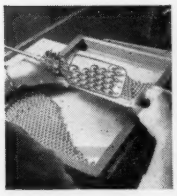

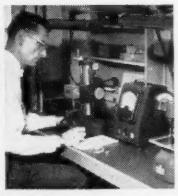

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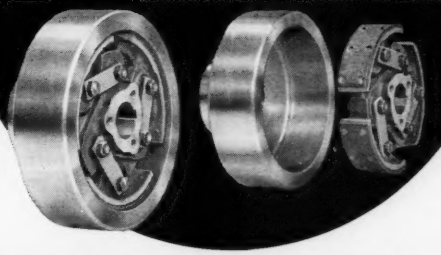
Circle number 131 on time saver card

Flexible ACTION IN THE *New* HILLIARD TWIFLEX

AUTOMATIC CENTRIFUGAL CLUTCH COUPLING



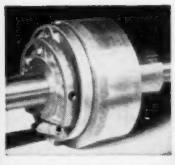
11 *NEW* IMPORTANT FEATURES . .

1. Flexible in all directions.
2. Absorbs Shock.
3. Limits torsional vibration.
4. Has adjustable idle speed
5. Can be furnished in automatic free-wheeling type.
6. Smooth starting.
7. No slip under normal load at full speed.
8. Protects driver and driven mechanisms against overload shock.
9. Can be furnished in automatic backstop type.
10. Prevents torsional resonance.
11. Easily assembled even in blind installations.

If you have problems of misalignment - smooth starting - vibration - overload - or assembly in the manufacture or operation of:

- Compressors
- Blowers
- Diesel Engines
- Excavators
- Refrigeration
- Hammer Mills
- Textile Machinery
- Wire Machines
- Fans
- Gasoline Engines
- Back Stop Brakes
- Mixers
- Conveyors
- Pumps
- Electric Motors
- Generators
- High Speed Pulverizers
- Tube Mills

• Let Our Engineers Consider Your Problem. Twiflex May Be The Answer.



OVER-RUNNING CLUTCH

For automatic engagement and release on two speed drives, dual drives and for ratchet feed or backstop action.
Write for Bulletin 231.

SLIP CLUTCH

For overload protection — constant torque — constant tension on reeling or winding stands.
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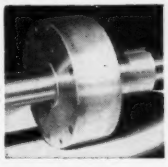
SINGLE REVOLUTION CLUTCH

For automatic, accurate control, electrically or mechanically, of intermittent motion, indexing, cycling, cut-off.
Write for Bulletin 239.



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MANUFACTURING CLUTCHES FOR 50 YEARS

Pillow-block bearings: economical answer to light loads

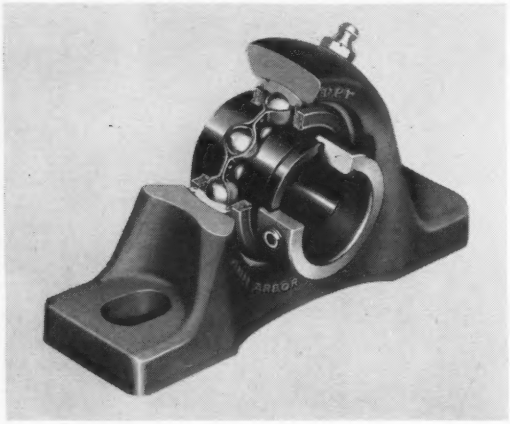
Economical pillow-block bearings (with durable housings of a ductile material that resists shock and vibration) are among the ball-bearing units of Hoover Ball and Bearing Company.

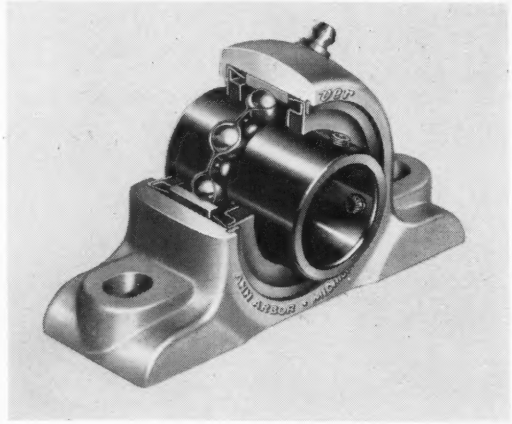
These bearings (together with their companion flange bearings, also with ductile housings) are designed to meet the need for cheap, but quality-made, units able to carry light loads at normal speeds.

The bearings are made with an extended inner ring, two set screws for locking the bearing to the shaft and elongated bolt holes for easy mounting. Other construction features include: compensation for normal shaft misalignment, factory lubrication, effective neoprene seals and a standard grease fitting for service requiring relubrication. The pillow block units are available in shaft sizes from ½ to 1 3/16 in.

Also included in the new line of pillow block and flange bearings are units with heavy cast-iron housings for normal duty. Design of these units includes an eccentric collar-type shaft lock and automatic self-alignment, achieved because the bearing is spherically seated in a matching spherical housing socket. Felt seals and metal shields effectively lock the lubricant in (and contaminants out). Where service requires, relubrication is simplified by a standard grease fitting. Shaft sizes from ¾ to 2 15/16 in. are available.

(209)



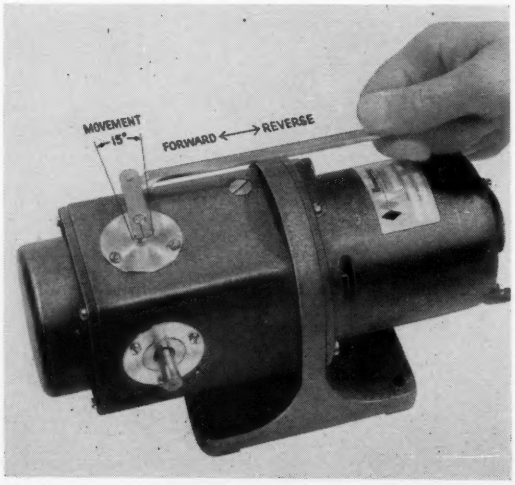


Variable speed drive: automatic control applications

For automatic control applications of the Servotran, the new mechanical variable speed drive for up to ¼ hp, Humphrey Products can supply this lever and push rod speed control. The speed control shaft moves through an arc of only 15 deg to change from full-speed forward to full-speed backward in less than 1/10 sec without disengaging the load. A torque of only 2 or 3 in.-oz on the control shaft is required. This ease of speed control makes the drive ideal for automatic control applications, because very slight control forces fed back from the system will provide all the necessary control without requiring amplification. These control forces could be the weight of the material, winding tension, hydraulic or pneumatic pressure or other similar variables.

The output torque is constant and the efficiency is between 85% and 95%. The speed is infinitely variable over the full range. The Servotran makes an ideal integrator for computers and weighing systems. It is also available with a solenoid-operated instant electric shift or with an accurately calibrated dial for manual adjustment.

(210)



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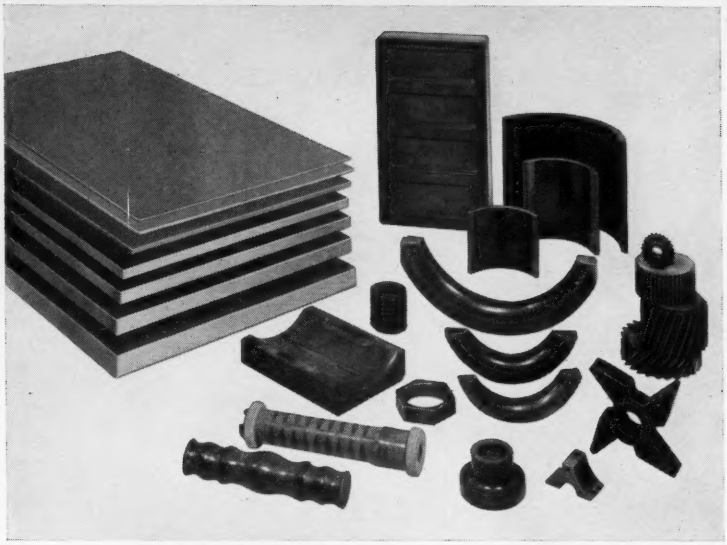

This versatile laminated plastic can be punched, cut or drilled. It is resilient, tough, stable and highly resistant to dilute acids and alkalis.

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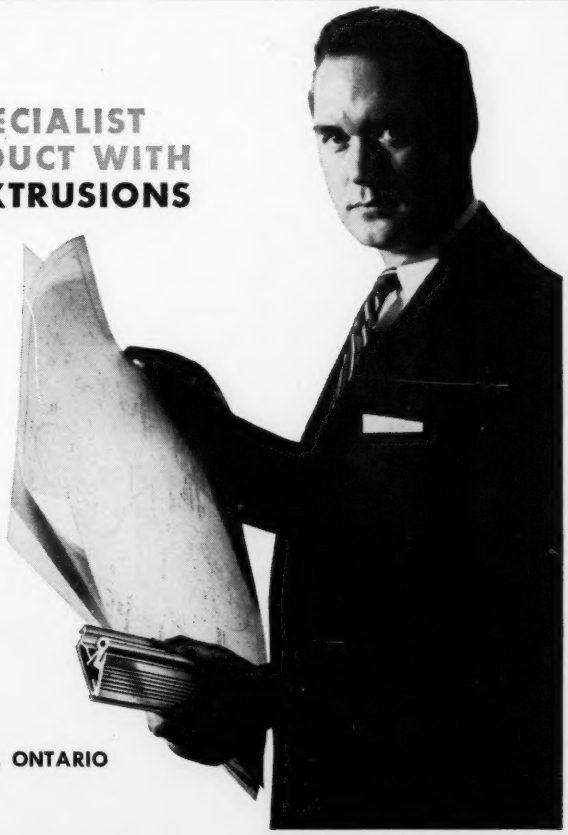
"ALUMINUM EXTRUSIONS FOR PRODUCTS OF BETTER DESIGN"



WERNER ALUMINUM

R. D. WERNER CO. (CANADA) LIMITED, OSHAWA, ONTARIO

Circle number 157 on time saver card

Tool steel: has long life in die-casting

Following a series of field tests at Arvin Industries, Inc. it was discovered that die life can be increased 360% by switching to a special tool steel for use in die-casting dies.

The company makes seal rotor laminations for fan-forced electric-heater motors by centrifugally die-casting molten aluminum around the laminations, with the motor shafts already inserted.

This meant that the molding had to be fast, for low-cost production. The probiem was to avoid extra setups of dies, eliminate machine down-time, make maximum use of labor hours, and decrease the reject of rotors caused by fast die wear.

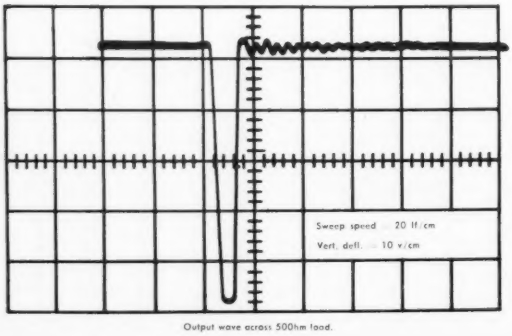
Die wear was especially short. Some dies lasted only 2 hrs, with an average life of from 8 to 40 hrs. In such a high production shop, this meant that two men were kept busy full-time producing molds in order to get high end product quality and interchangeability of the parts produced.

Allegheny Ludlum Steel Corporation engineers were called in. They suggested a change in the die material. The switch was made to Potomac M with L-XX (T-1) high speed steel inserts. Potomac M is a 5% chromium, 1% vanadium tool steel selected for its toughness and resistance to wear at elevated temperatures. The inserts accurately shape the rotor ends and must resist tempering and reproduce sharp detail on extremely long production runs.

The average age of the trial dies was more than 2 years without failure. **(211)**

Pulse generators: jitter-free and fast rise

Model 1051 milli-micro-second current pulse generator (Rese Engineering, Inc.) produces high amplitude, ultra-short duration current pulses for development and design applications in high speed logic and memory problems, solid state research and high-speed transistor switching operations.



Output wave across 500hm load.

Featuring jitter-free pulses with rise times as fast as 5 milli-micro-seconds, it generates positive or negative pulses at ground level with durations of 10, 20, 50 and 100 light feet. (1 lf = 1 milli-micro-second). Pulse amplitudes are continuously variable from 0 to more than 2 amps, and pulse repetition frequency is continuously variable from 100 to 10,000 pps. The very fast rise time (less than 5 lf for pulse widths of 10 lf) makes the instrument invaluable for thin magnetic film studies, diode and transistor switching and recovery studies, and basic magnetic switching research. The combination of fast rise time and high current output is most effective for high speed ferrite core and multi-apertured ferrite device studies.

In addition to periodic operation from internal clock timing, the 1051 may be triggered from an external source, or may be manually operated from a front panel push button. A sync pulse is produced 50 lf before the main current pulse output occurs, permitting easy observation of the generated wave or of the load response. To accommodate intermediate pulse widths, or widths in excess of 100 lf, provision is made for connecting external timing coaxial lines from a front panel connector. **(212)**

continued ▶

NEW *Switch Versatility!*

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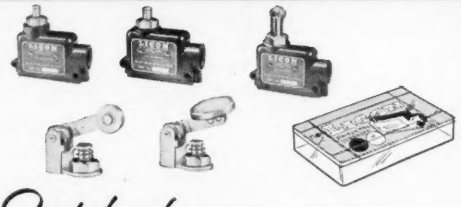
Type 30 Precision Enclosed Switch

6 components form 16 switch types!

Rugged, dependable, long-life Licon Type 30 offers adaptability never before possible for precision limit, safety and interlock control. Three complete switch types, two actuators and auxiliary base mounting plates form sixteen different industrial switch modifications. Available with improved sealing feature, or unsealed, Licon Type 30 Switches save switch replacement costs. Write for New Licon Type 30 Switchpak Bulletin No. L-101.



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Handy plastic kit contains three complete switches, two accessory actuators and optional base mounting plates. Perfect for on-the-job maintenance. Have the right switch at the right time—get Switchpak containing . . .

Sealed Plunger Switch • Overtravel Plunger Switch • Roller Plunger Switch • Palm Button Actuator • Lever Actuator and three optional base mounting plates

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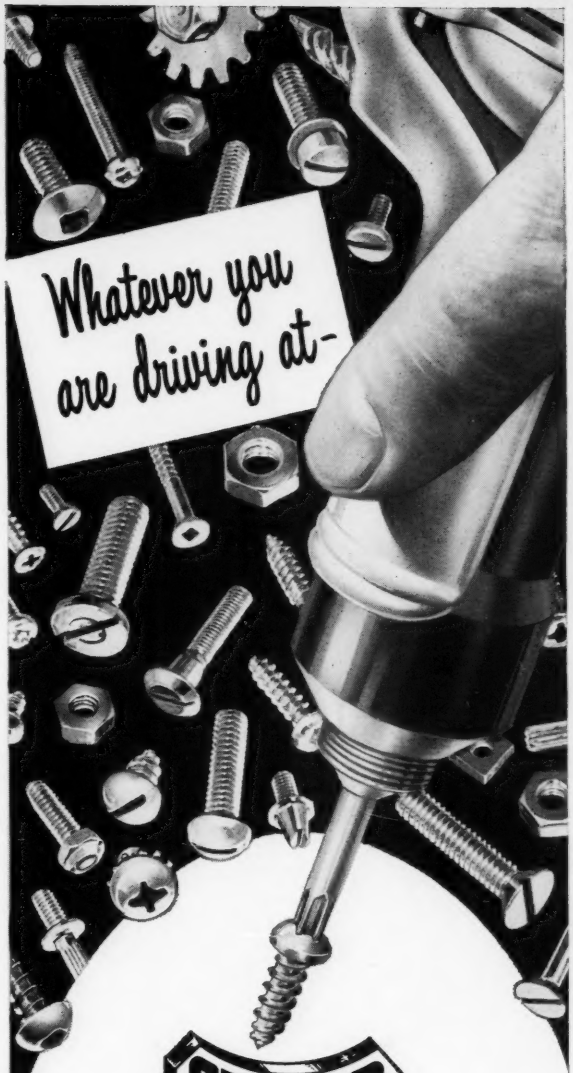

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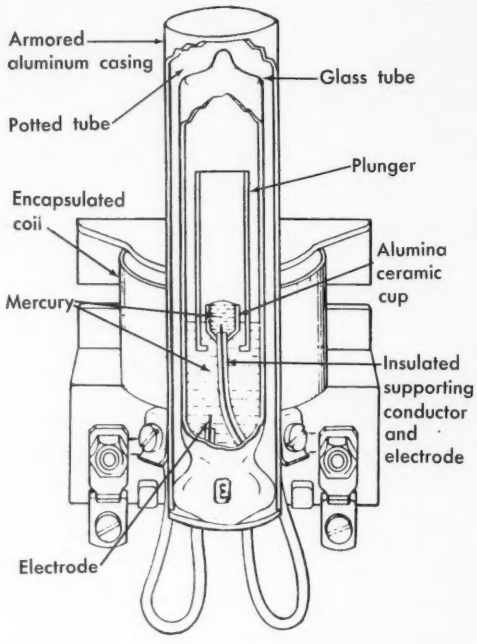
Circle number 149 on time saver card

Electronic relays: encapsulated coil halts deterioration

To provide the protection necessary for efficient operation in corrosive, deteriorative atmospheres, Philips Electronics Industries Ltd. have announced the development of a fully encapsulated coil for use with their line of Ebert relays. Shown here is the EM-1 relay with encapsulated coil and tube. In addition to the moisture-resistant, vacuum impregnated, cotton interweave coils (employed in all Ebert relays) their encapsulation in an approved polyester resin compound offers additional protection, where amospheric conditions are vigorous. This often does away with the need for bulky, expensive housings.

Since all these relays have hermetically sealed, mercury-to-mercury contacts, protection against environment is also afforded to the relay mechanism, so that millions of silent service-free operations under the most adverse conditions are possible. Suitable for applications involving outdoor switching, lighting, motor control, air conditioning and heating, alarm and call systems, communications equipment, plant production and maintenance equipment, this encapsulated coil (with hermetically sealed mercury-to-mercury contacts) offers extreme reliability. **(213)**



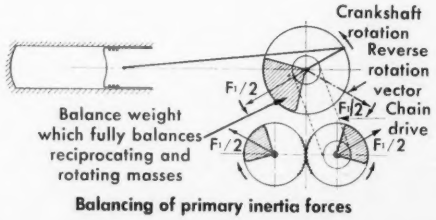
Balancing engines: careful with the counterweights

The problem of balancing the rotating and reciprocating components of high-speed engines has engaged the attention of engineers for many years.

Unbalanced rotating forces may readily be dealt with by the addition of counterweights to the crankshaft. Extravagant use of these is to be avoided, however, for they increase engine weight and cost, and the additional rotational inertia which they produce may lead to difficulties in dealing with torsional vibration. It is pointed out by R. Clink (in *The Chartered Mechanical Engineer*) that where such weights are necessary from the balance aspect, they may be designed as pendulum vibration absorbers, to produce an engine which is smoother in a torsional sense.

Unbalanced inertia forces are normally dealt with by selecting an engine assembly that provides collective balance of the forces at the individual cylinders. The author considers that one of the best methods of studying these effects is by means of reverse rotation vectors. This method gives a clear picture of the resultant unbalance effect of different engine arrangements, and a ready means of finding the best solution. The representation of reciprocating forces by means of reverse rotation vectors is not new; it was, in fact, the basis of the Lanchester second-order balancer for four-cylinder, in-line engines.

The author reviews and discusses some of the engine balancing arrangements in current use in the automobile industry. Mention is also made of some of the more important practical problems encountered when carrying out actual balancing operations on crankshafts and their associated components. **(214)**



Balancing of primary inertia forces

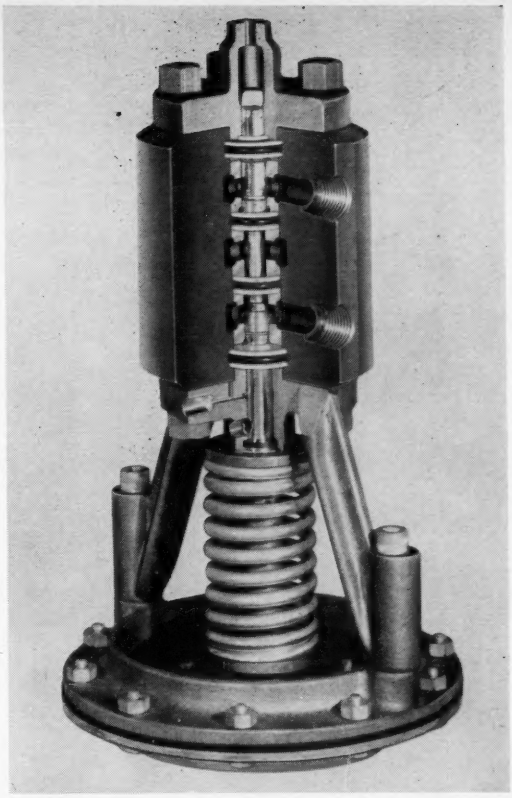
continued ▶

High pressure valve

Use of internal sleeve type construction in the entire S-C line of diaphragm-operated, high pressure valves for hydraulic or cold raw water service (to provide shockless performance and leakfree shut-off with minimum maintenance) is announced by The Sinclair-Collins Valve Company.

In this design, the valve seats are integral in a replaceable hardened stainless steel sleeve. Commercial standard O-rings in molded Teflon back-ups provide a flexible seal between the sleeve and valve body. Positive leakless shut-off is claimed because seating cannot be affected by minute deflections or breathing of the valve body under high pressures. Hydraulic shock or pressure surges in the lines will not cause distortion of the seats with consequent leakage, wire-drawing or cutting (it is claimed) because the O-ring seals compensate for any unavoidable body deflections and preserve constant concentricity of the seat sleeve and stem. Porting in the seat sleeve is said to be designed for negligible flow loss as the stem shifts from seat to seat, thus minimizing loss of inlet pressure to drain.

In addition, this sleeve design will prevent the leakage commonly encountered in high pressure valves using screwed-in seats, where breathing of the valve body under pressure allows the seats to loosen and leak. **(215)**



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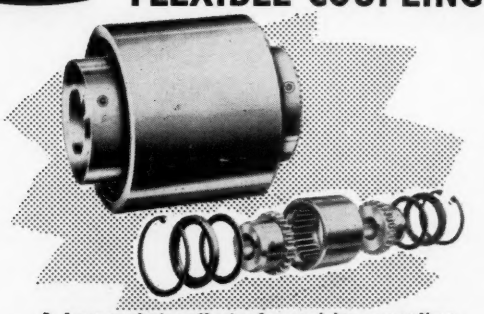

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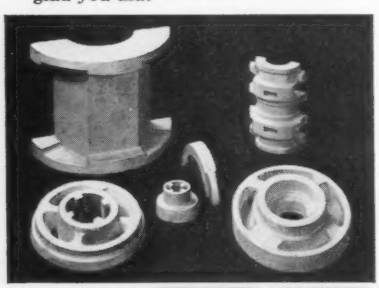
BEARIUM METAL'S amazing superiority is due to the uniform dispersion of microscopic lead particles within the copper-tin grains rather than between the grain boundaries as found in ordinary bronzes. Result is that it will not seize or score the shaft nor will it melt out like babbitt—even in applications where a liquid other than oil must be used as the lubricant.

If you have a bearing application calling for dependable, trouble-free performance, by all means BEARIUM METAL *is your best buy in bearing bronze.* Try it on one of your toughest jobs. You'll be glad you did!



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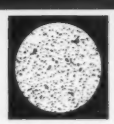

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FEATURES: Non-Seizing and Non-Scoring • Long-Wearing • Self-Lubricating • Low Coefficient of Friction • High Compressive Strength • Resistant to Shock Loads • Sound, Uniform Structure.

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Circle number 107 on time saver card

People in the news

J. C. R. Warren has been appointed co-ordinator of Research and Development of the Dominion Rubber Co. Ltd. He will make his headquarters at the company's research laboratory at Guelph, Ont. Warren is the author of several papers, and has been granted 19 patents in the chemical field.

Warren

Vaughan

A graduate of McGill in mechanical engineering, **Robert P. Vaughan** becomes sales engineer in the paper division of Dominion Engineering Works Ltd. Vaughan will supervise all sales engineering work for the western mills and some companies and mills in Quebec.

From Northern Electric Co. comes news of three appointments. **J. R. Houghton,** asst. mgr. of the communications equipment division, assumes the additional appointment of manager of the company's London, Ont., plant. He is a mechanical engineering graduate of McGill. Scarborough, Ont., born **D. K. Atkinson** becomes sales manager of the company's eastern zone. He graduated with a BA. with honors in mathematics and physics in 1929 from Queen's University and joined the company in 1930. Rounding out the appointments is that of **L. G. Bartlett** who takes over as sales manager of the western zone.

Cowan

Gage

Manager of Daystrom Ltd. since its establishment in Canada early in 1957, **H. W. Cowan** has been appointed v-p and general manager.

At the 27th annual meeting of the American Society of Tool Engineers, **Bruce Fairgrieve,** v-p of Fairgrieve and Son Ltd., Toronto, was elected to the board of directors for the 1959-60 term of office.

Four administrative promotions within the sales department of General Motors Diesel Ltd., London, Ont. **Russell Gage** to the newly created position of assistant to the general sales manager. Joining GM in 1930, he has held varied engineering, service and sales assignments. **H. F. Shepherd** has been appointed manager of diesel engine sales. He was formerly parts manager, and had been district engineer, Calgary. Supervising locomotive sales engineering activities since 1956, **P. G. Brewer** becomes parts manager.

Shepherd

Brewer

Queen's graduate **L. S. Murray** takes over the responsibilities of locomotive sales engineering supervisor. He has been a project and sales engineer.

Wright

Dewar

R. W. Wright has been appointed by Canadian Allis-Chalmers Ltd. as manager of Sales-Falk products. He is a graduate of Dalhousie and McGill universities in science and engineering.

John S. Dewar was recently elected a director of Union Carbide Canada Ltd. He is v-p operations and a graduate in chemical engineering of Queen's University. Elected to the newly created office of executive v-p is **F. Perry Wilson,** a graduate chemical engineer. He has held many senior executive posts since joining the Bakelite organization in 1941.

A graduate of the University of Alberta, **W. Harvey Prevey** has been appointed manager, application engineering and system sales for the industrial products department of Canadian General Electric.

Wilson

Prevey

Robert M. Love becomes sales manager distribution and instrument transformers in the same organization. Love is a member of several professional engineering societies. ★

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BLOOD BROTHERS UNIVERSAL JOINTS
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UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

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New products

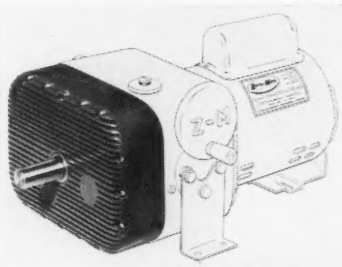
Continued from page 67

bers, in the straight through bore, are formed with metal spacers held rigidly in metal end abutment. The spacers support and accurately position the "O"-rings which form the valve chambers. The stainless steel valve plunger is hollow and radially ported.

These valves can be manifolded together easily and quickly without requiring any special parts. **Hunt Valve Co.** **(218)**

Two-Step gearheads

A series of two-step gearheads now multiplies the speed range or torque of Zero-Bax variable speed controls up to 4½ times, says, **Revco Inc.** This increases the speed range from 0-400 rpm to 0-2,000 rpm, or raises the torque limit from 100 in. lb to 450 in. lb.



The new gearheads are available in eight ratios. Gear reduction increases torque and cuts the speed range while gear increase reduces torque and increases speed range. Housed in a short extension of the case gearheads become an integral part of the unit with common lubrication.

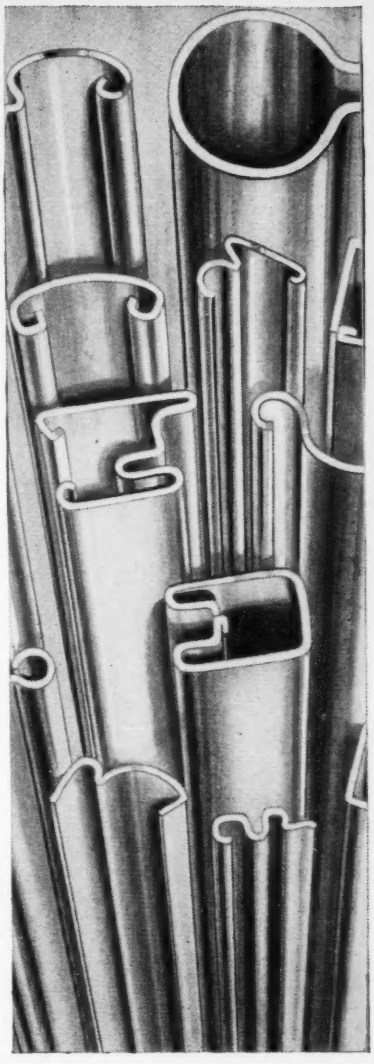
Unit has direct positive power linkage through cams and over-riding clutches. Speed can be instantly and accurately changed by moving a lever or turning a screw control whether unit is running or stopped, say the makers. **(219)**

Plug-in industrial relays

A range of heavy-duty industrial relays, that can be plugged into special receptacles, and removed for inspection or replacement in a matter of seconds, is now available from **Arrow-Hart and Hegeman Ltd.**

Designed for use on machine tool sequence controls, with refrigeration and heating equipment, and on many other applications, the relays can be supplied in 2, 3, 4, 6 and 8 pole types, in 10 amp. and 15 amp. 600 V. a-c ratings. They are available as elementary relays, with latching attachments, and with plug-in receptacles. The various components can also be purchased separately. **(220)**

(Continued on page 78)



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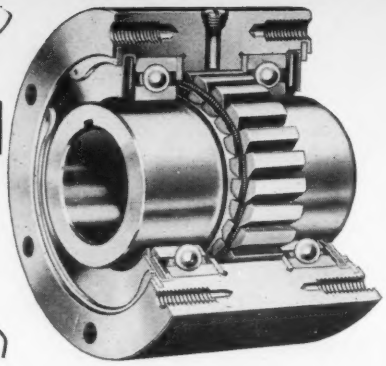

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MANY sprags (wedges) form the heart of the FORMSPRAG clutch. In over-running, indexing and backstopping actions, they combine to give a powerful grip—instantly—around the full circumference of the shaft. Due to their unique "wedging" action, almost no movement of the sprags is required, so the *full grip* or *complete release* of the clutch is *instantaneous*—*time after time*—*firm and sure.*

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New products

(Continued from page 77)

Speed increaser unit

The Industrial Division of the **Snow-Nabstedt Gear Corp.** has announced the application of their High Speed Gear Increaser Units in the testing of oil seals under extreme conditions.

Specifications for this standard S-N Series 4100 Speed Increaser Units are: capacity — 50 hp over an output range of 35,000 to 80,000 rpm; gearing — Helical type, single-stage; input speeds up to 10,000 rpm; output speeds to 80,000 rpm; ratios 1:5.0 and 1:8.0. All units may be supplied with stub shafts or aviation accessory drives as standard equipment. The engineering staff at Snow-Nabstadt will also design and build speed increaser units to meet special requirements. **(221)**

Electric erasing machine

A new hollow shaft electric erasing machine announced by **Charles Bruning Co.**

(Canada) Ltd., is designed for use in both office and drafting work. The unit is set in operation at 3100 rpm by a slight index-finger pressure on a sensitive switch. A nonslip gripping surface on the light weight, aluminum case with baked enamel finish permits easy handling. The case, which is tapered for pencil-like manipulation is symmetrically contoured. The same unit can be used for pointing draftsmen's refillable pencils by means of a pencil attachment that fits into the hollow shaft on the back of the macihne. Thus, the pointer can be installed without disturbing the opposite end of the machine, where the eraser is held. The attachment does not interfere with hanging of the machine for storage. **(222)**

Ignition coil

An ignition coil for small four- and two-cycle industrial engines makes its debut.

The new product represents an "engineering and manufacturing breakthrough" in the long pursued attempt to produce an ignition coil with total epoxy impregnation and encapsulation of the coil for complete indestructibility from physical vibration and impact.

The company, **Pacific Mercury,** say

(Continued on page 79)

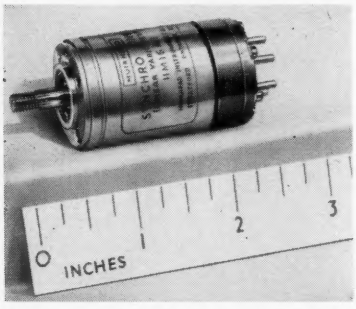
New products

Continued from page 78

they have succeeded in winding the ignition coil with extremely small diameter conductors. The entire unit is impregnated with epoxy plastic. Thus, in addition to complete protection from physical shock, the ignition coil is protected from chemical attack and is impermeable to moisture and humidity. **(223)**

Linear variometer

This small size, low weight instrument, housed in a standard Bu-Ord Size 11 synchro frame, has a voltage output proportional to rotor angle rising to 42.5 volts.



A special patented design of the rotor and stator lamination gives a smooth variation of output voltage devoid of any fluctuations due to tooth ripple.

The linvar can be applied to satisfy the requirements of analogue computation, remote control or indication, and may be operated by mechanical measuring devices, e.g., strain and deflexion gauges weighing machines etc., where an a.c. output voltage varying linearly with deflexion is required. — **Muirhead Instruments Ltd.** **(224)**

Helicon geared motor units

Complete economy is claimed through the installation of David Brown Helicon geared motor units, because they provide low initial cost, conserve valuable floor space and require little maintenance. The latter consists of only and occasional oil level check.

Absolute stability and precise alignment of gears and shafts due to substantial gear case and housing is also assured by **David Brown (Canada) Ltd.**

Other features include: Metric type bearings for ample margin for normal journal and thrust loads, a roller bearing for overhung loads on output shaft from pinion, sprocket or V-belt drives; high tensile and heat treated alloy steel large diameter shafts ample to deal with torsional or bending loads and ground all over output shafts; self-contained lubrication system for gears and bearings. **(225)**

High pressure packless solenoid valve

This Ansco high-pressure, low-temperature solenoid valve was developed to control air, gases and liquids to 2,500 psi, for temperatures from —65 deg. F to 160 deg. F, say **Davis Automatic Controls.**

The valve body and operating parts are of stainless steel, eliminating many corrosion problems. It has packless construction — there are no stuffing boxes or sliding glands that require maintenance.

This new high-pressure solenoid valve is available with Nema 1, Nema 1V, or 1X and 1XA Solenoid Enclosures, ¼ in. N.P.T. or A.N.D. Connections and Standard, Threaded or A.N. electrical connections. **(226)**

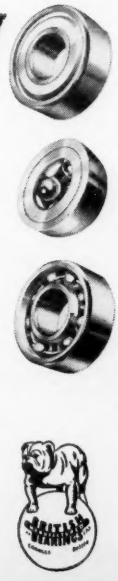
Battery-operated hydraulic elevator

Lightweight, compact construction, is prominent in an elevator designed for rugged heavy-duty service. Platform and straddle fork models are available.

The elevator is equipped with 12-volt heavy-duty Autolite lifting motor. Hydraulic lifting unit is complete with integral oil reservoir and control valve. Lifting ram is of large diameter to keep oil pressure low, and cylinder is equipped with spring-mounted chevron packing.

Capacity is 1,000 lb., with maximum lifting speed of 35 fpm. **S. A. Armstrong Ltd.** **(227)** ★

B·M·B mini-bearings



are manufactured to meet the spread of miniaturization and high precision limits required in many fields of Canadian industry.

A complete range of **B·M·B Mini-bearings** in both metric and inch sizes, which include flanged, shielded and pivot types, are available. Bore diameters range from .03937 inches up to ¼".

Bearings are manufactured to American ABEC specifications.

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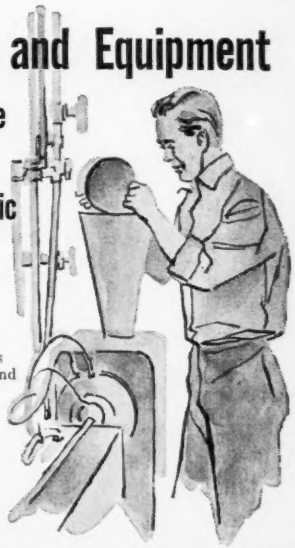

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Rugged Alemite Hose is available for either medium-high or high-pressure service, with single or double wire braid. Couplings of high-strength steel have J.I.C. thread design for positive, long-lasting seal.

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- **NO SPECIAL ASSEMBLY TOOLS REQUIRED! Fast, easy assembly with just ordinary tools.**
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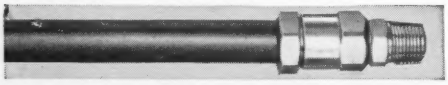

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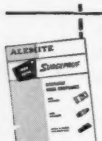

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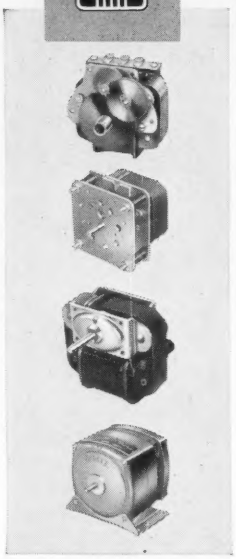

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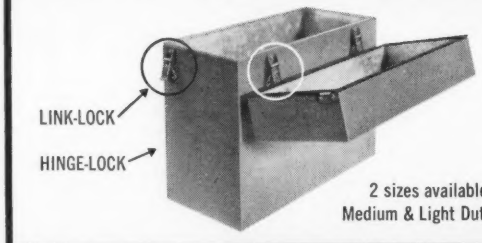
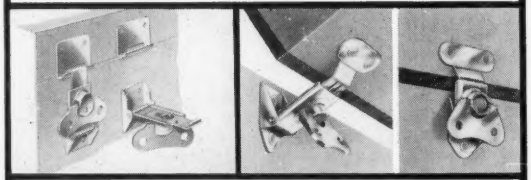


2 sizes available:
Medium & Light Duty



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NEW Super-Sealing Gasket Material
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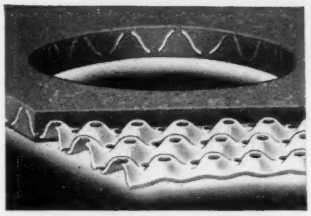

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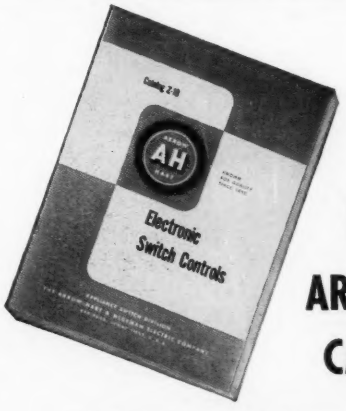

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Editorial

Increased productivity required

"If Canadian-made goods are to compete successfully in world markets with those produced in Europe and Asia, we must continue to increase productivity and at the same time, maintain high standards of quality."

The speaker was Mr. C. T. Carson, P.Eng., of Windsor, Ontario, past president of the APEO, addressing a regional meeting of professional engineers in Ottawa.

What he said applies equally to all engineers in Canada. It applies with special emphasis to design engineers and the designing function which they and their associates perform.

The design engineer has an important part to play in meeting this challenge of outside competition. New machinery, automated production processes, improved product design and other developments which would contribute to increased efficiency are all in the designer's domain.

What can we, as a profession, do?

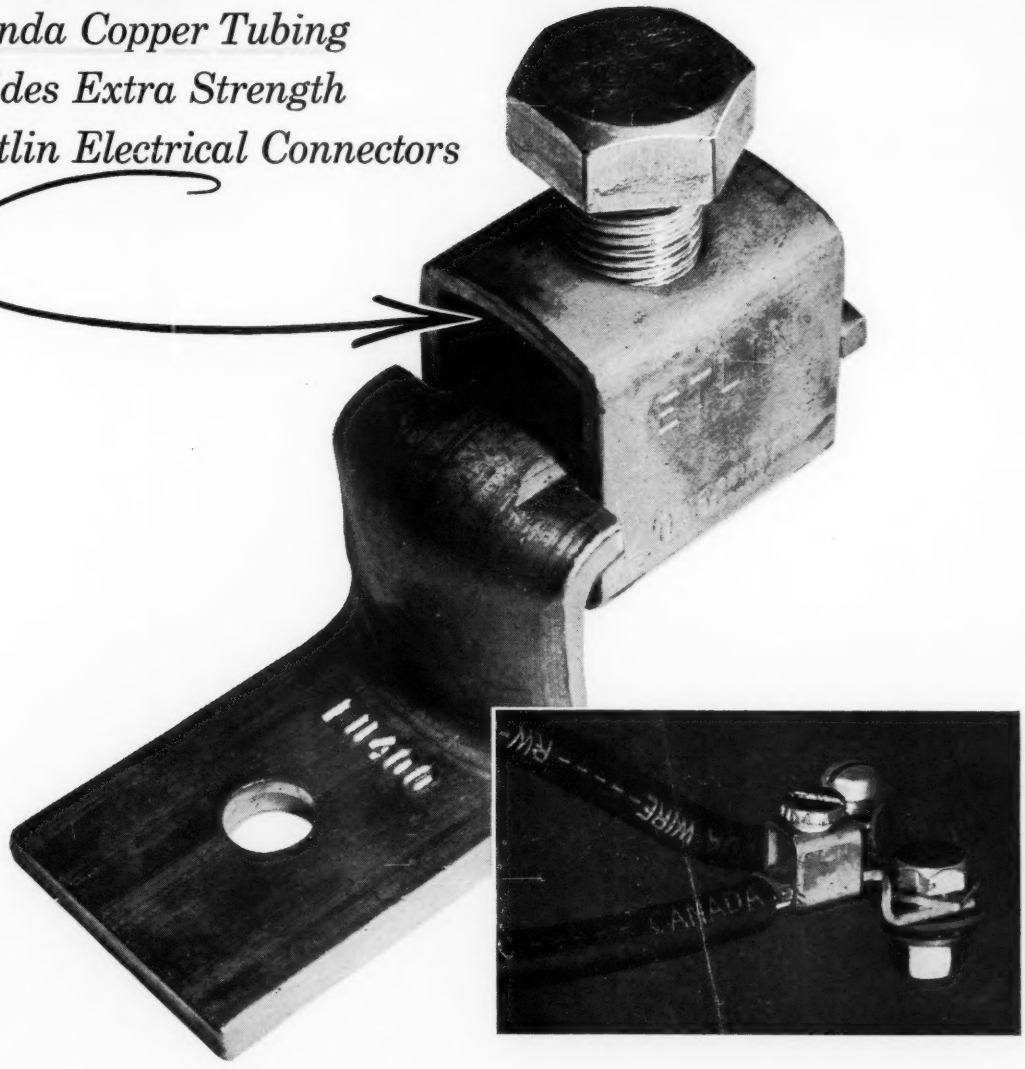
First of all, we can, as Mr. Carson pointed out, take action to increase our productivity—and we are not referring to the production rate of some piece of machinery or equipment. We are referring specifically to the production rate of the engineer as an individual worker. More new ideas are wanted; greater imagination must be brought to bear on our assignments; more strenous effort must be expended, even on the routine tasks.

Engineers can call for elimination of "engineering wastage" where trained engineers are employed in sub-technical jobs. Engineers should not be forced to withhold their talents under any circumstances. It is only by the concentrated application of these same talents that we can ever hope to keep Canada in the forefront as a world supplier of industrial goods.

Engineers can play an increasingly important role in the government of our country, from the smallest municipality to the federal cabinet. This is a subject on which we will have more to say at a later date.

Doug Kaill

Specially Shaped Noranda Copper Tubing Provides Extra Strength for Etlin Electrical Connectors



Seamless, pure electrolytic copper tubing is produced by Noranda in a selection of special shapes for electrical solderless connectors. The H. B. Etlin Company, Toronto, one of Canada's major electrical equipment manufacturers, uses the heavy walled five-sided shape illustrated here.

Noranda seamless copper tubing is preferred because of its high mechanical strength as well as electrical conductivity. The tongues are fabricated from heavy Noranda Copper bus-bar for rigid clamping and low heat loss. Ampere range for these connectors is from 25 to 800 inclusive.

Fulfilling special product and component needs is standard practice at Noranda. Noranda technical service stands ready to serve you, your product and production needs—both present and contemplated—on any copper and copper alloy subject, size or shape. A call to your nearest Noranda Sales Office will bring whatever assistance or information you require.

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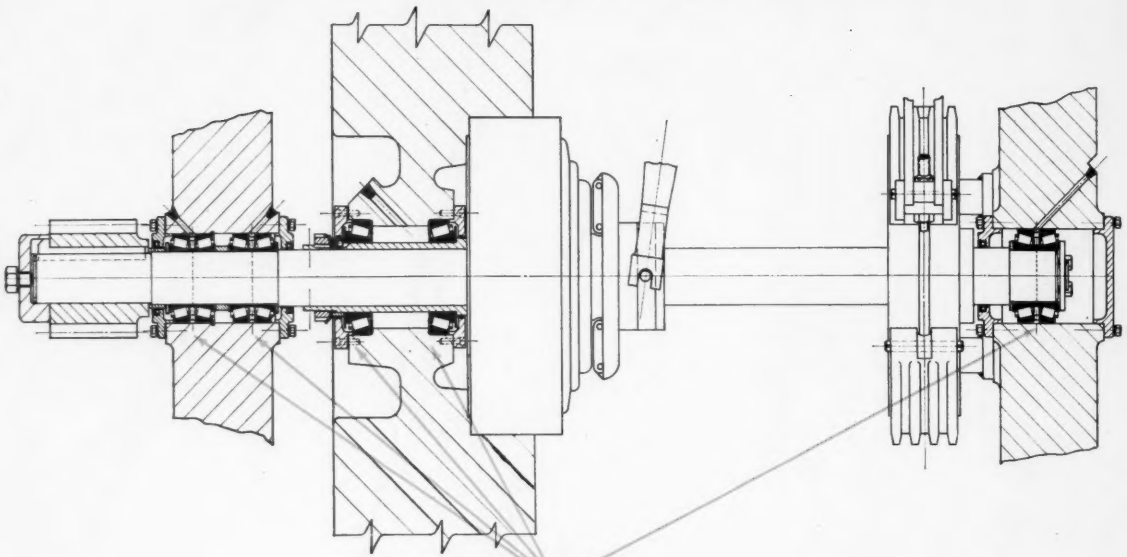
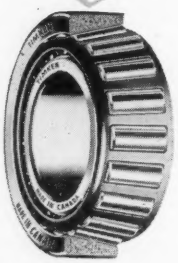
How to keep a power press from losing its punch

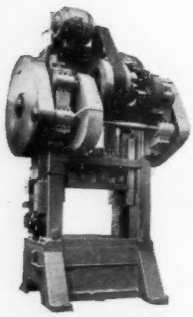


Brown-Boggs Foundry & Machine Co. Ltd., all Canadian owned machine tool designers and manufacturers since 1890, says...



"We always use Timken bearings because we know they'll take the heavy shock loads.

Timken bearings assure our customers of built-in low maintenance."



"This Brown-Boggs No. 475-52 Straight Side Double Crank Press has many outstanding, performance boosting features. For example, it's equipped with a Friction Clutch and Spring Loaded Brake, each air operated, electrically controlled and synchronized for fast, smooth starting and positive stopping. Standard equipment also includes motorized ram adjustment. Then to take the heavy shock load when the ram, carrying the punch, strikes the work, the drive shaft, intermediate shaft and drive pulley are mounted on Timken tapered roller bearings. (See diagram above for typical drive shaft mounting.) Timken bearings assure longer life with minimum maintenance because:"

1. Their tapered construction lets Timken bearings take both radial and thrust loads in any combination.

2. Full line contact between rollers and races gives Timken bearings extra load-carrying capacity. And their incredibly smooth surface finish practically eliminates friction.

3. Timken bearings hold shafts concentric with their housings, making closures more effective to keep dirt out, lubricant in.

4. Only the finest bearing steel is used. We make it ourselves to be sure. No other American bearing manufacturer does.

For better machines when you build or buy them, make sure they're equipped with Timken tapered roller bearings. The Timken Roller Bearing Company, Canton 6, Ohio. **CANADIAN PLANT:** St. Thomas, Ontario. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

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